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A REPLY TO A moſt Partial PAMPHLET,

ENTITLED,

A Letter from a BY-STANDER,

TO THE

COMMISSIONERS

FOR

Re-building the Bridge, at *Briſtol.*

By a CITIZEN.

K

> I had not thought to have unlockt my Lips
> In this unhallow'd Air, but that this Jugler
> Would think to charm my Judgement, as mine Eyes,
> Obtruding falſe Rules prankt in Reaſon's Garb.
> I hate when Vice can bolt her Arguments,
> And Virtue has no Tongue to check her Pride.
>
> MILTON.

BATH:

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MDCCLXII.

The *DEDICATION.*

TO THE

COMMISSIONERS

FOR

Re-building the BRIDGE

At *BRISTOL.*

GENTLEMEN,

YOU are deſired ſeriouſly and attentively to read and conſider the following Sheets, as they were wrote for your Information, and to ſerve the Public, by,

GENTLEMEN,

Your moſt humble Servant,

The Author.

A REPLY
TO
A moſt Partial PAMPHLET,
ENTITLED,
A LETTER, &c. from a BY-STANDER.

THE little Regard paid either to good Manners, or to Truth in a Letter to the Commiſſioners for re-building the Bridge at *Briſtol*, from an Author who ſubſcribes himſelf a BY-STANDER, has prompted me to conſider the ſeveral Plans offered for that Building, and to give my Thoughts on ſo important a Work to the Public; endeavouring to reſcue Mr. *Wood*'s, and Mr. *Stratford*'s Deſigns from the Miſrepreſentations of the above Author; and to ſet in a proper Light thoſe of Mr. *Bridges*, who, as an Author, is a mere Plagiary, which will be proved in the Courſe of this Reply; and whoſe Plans for the Bridge will be ſhewn to be ALL impracticable.

The By-ſtander tells us, that Mr. *Wood*'s Drawings are * *neither neat nor maſterly*: A Fact ſo contrary to Truth, that it at once ſhews the Partiality of the Author, and his Ignorance in Matters of this Kind; for to any Judge, Mr. *Wood*'s Drawings will appear both *neat* and *maſterly*, notwithſtanding the ſhort Space of Time † he had to perform them in, and much ſuperior to thoſe of Mr. *Bridges*, though ornamented with gilt Frames and Glaſſes, and though the Produce of ‡ *three Years* Study and Conſideration.

The By-ſtander is ſo diſingenious, as to mention only ONE § Deſign of Mr. *Wood*'s, and even that he miſrepreſents, by telling us, it is *finiſhed with an Iron Rail,* ‖ *whoſe Appearance will be mean*; and further ſays, that Mr. *Wood* calls this *his Roman* ¶ *Bridge*.

Now Mr. *Wood* offers no leſs than FOUR Deſigns; in his firſt Letter he gives us *two*; one with *three* Arches; and another with *one* Arch on *new* Foundations, he greatly diſapproves of uſing the *old* Foundations, and gives great and good Reaſons for his Opinion.

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* See the By-ſtander's Letter, Page 18.

† Only a few Days. See Mr. *Wood's* firſt Letter to the Commiſſioners, Page 5.

‡ See Mr. *Bridges's* Letter to the Commiſſioners, Page 56.

§ By-ſtander's Letter, P. 17. ‖ Ib. P. 21. ¶ Ib. P. 18.

In his ſecond Letter, finding it to be the general Wiſh to uſe the *old* Foundations, he points out a Method of uſing them, by a *ſingle Arch*, that is to ſpring from the Center of the *Redcliff*, to the Center of the St. *Nicholas* Peir.

His *fourth* Deſign, which he offered to the Commiſſioners, *October* the 20th, 1760, is a * Bridge with *three Arches*, the Center one *eliptical*, the two ſide ones *ſemicircular*, on the *old* Foundations.

Again, the Bridge with *eliptical* Arches firſt offered by Mr. *Wood* is crowned with a *Balluſtrade*. But ſuppoſe it was with a *Rail*, as the By-ſtander tells us; Is this then a Fault in Mr. *Wood*, when it is none in Mr. *Bridges* to crown one of his Bridges with a ridiculous *Chineſe* Paling?

And laſtly Mr. *Wood* has not ſo much as made Uſe of the Term *Roman Bridge* in either of his Letters to the Commiſſioners.

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* This appears to be the beſt Method yet offered for uſing the *old* Foundations, with a *three Arched* Bridge. There are a few Objections to be made to it, which I dare ſay Mr. *Wood* can eaſily obviate; but I am afraid the Plan has not had that due Attention paid to it that it deſerves; and therefore wiſh the Commiſſioners would give it a thorough Examination; as they may poſſibly find that STRENGTH, BEAUTY, CONVENIENCE, and ŒCONOMY are more conſulted in it, than in any other they have ſeen. A particular Deſcription of this Deſign I propoſe to give my Readers before I finiſh this Reply.

The By-ſtander next endeavours to explode Mr. *Wood*'s Idea of raiſing the Bridge high, by an Objection that the Bank on the *Redcliff* Side muſt be raiſed thirteen Feet higher than it is at preſent; but this, and every Objection that Author makes concerning the Inconveniency of the Approach from St. *Thomas*, *Redcliff*, and the other Streets, are eaſily anſwered, when we ſuppoſe that the Commiſſioners would purchaſe to the Extent they are allowed to do by their Bridge-Act; and as that Act was the only Guide Mr. *Wood* tells us he had to direct him, it very reaſonably occurred to him, that it was the Intention of the Public to make Uſe of the whole of the Ground they were impowered to buy.

Expence is another Objection, and to compleat his Deſign* elevated ſo high would certainly be expenſive; but it is worthy Conſideration, whether the great Advantage that would ariſe from it to the Trade of the City, and to the Navigation of the River, together with its

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* Mr. *Wood* in his ſecond Letter, Page 13 ſays thus,—" I " am very ſenſible that it will appear to many that the raiſing the " Bridge will create a great Expence in the extraordinary Pur- " chaſe of ſome Houſes in *Redcliff-Street*, St. *Thomas-Street*, and " the *Back*; but if any one will take the Pains to calculate the " preſent Value of the Houſes, and conſider the Extent of thoſe " Houſes in Front, it will be very obvious that if a Number of " compact Houſes be built on that Ground, the *improved* " Ground-Rents will not fall far ſhort of the Purchaſe; and " the Advantage of the Vaults under the Streets will very well " pay for the raiſing of them."

Magnificence, would not ſufficiently make Amends. The Vaults under the Terraſſes, to the *North* and *South*, would become excellent Warehouſes to lodge Tobacco, Cyder, Salt, Meal, Corn, and other Merchandize, which from the Lighters and Barges might be eaſily landed, and re-ſhipped; or loaded on Carts with little or no Interruption in the Streets; while the River would be navigable at all Times of the Tide; and certainly, to have a large open Area in the Heart of the City of *Briſtol* terminated to the *North* and *South*, with regular Buildings; to the *Weſt* with a Bridge; and the River running thro' it is very deſirable.

Theſe Objections of Expence and Inconveniency are ſtill more eaſily obviated if Mr. *Wood*'s laſt Plan is followed, by which the *Redcliff* Bank will be raiſed not above *eight Feet*, and the Head Room under the Bridge at the higheſt Tides be of *that Dimenſion*. Mr. *Wood* in his Letter of the 20th of *October*, 1760, expreſſes himſelf thus: "I am really, "Gentlemen, of Opinion, that unleſs you "raiſe the Road of the Bridge *ten Feet ſix* "*Inches* higher than it is at preſent, you are "doing nothing. In this Caſe a Bridge with "*three* Arches will be moſt elligible; but "if you raiſe the Bridge as high as I firſt "propoſed, to be ſure a *ſingle Arch* is beſt; "but even then I would not adviſe it to be

“ more than *one hundred and twelve*, or *one*
“ *hundred and fourteen Feet* Span.”

Thus we ſee that Mr. *Wood* keeps to the Point of raiſing the Bridge; whilſt Mr. *Bridges*, even in his laſt Addreſs to the Commiſſioners, ſtill recommends a *large low ſingle Arch*; and tells us that it will not exceed the Scheme of *three ſemicircular* ones, on the old Foundation, above 4163 Pounds. Now as I ſhall preſently ſhew not only the Impropriety and Impracticability of ſo large an Arch in our Caſe; but alſo that a Bridge with *three Arches*, raiſed to the ſame Height with that of *one Arch*, will be more convenient, to the Navigation in particular; I may with Propriety ſay, that it would be more prudent, and more for the public Good, to expend the above 4163 Pounds in the Purchaſe of Houſes to enable us to raiſe the Bridge to the Height Mr. *Wood* adviſes us, than to fling it away in an *one Arch* Scheme.

As to Mr. *Stratford*'s Plan, tho' the Byſtander ludicrouſly compares the Drawing to a *Turkey* Carpet, yet it is ſuch a maſterly Piece of Work, that Mr. *Wood* would not be aſhamed to own it; and what Mr. *Bridges* may wiſh to imitate in vain; and by it, Mr. *Stratford* has ſhewn himſelf an excellent Draughts-man, and by his Letter an excellent Engineer.

I cannot help here obſerving, that both Mr. *Wood* * and Mr. *Stratford* agree in Opinion with Regard to the Hazard and Diffi-
culties

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* Mr. *Wood*, in his ſecond Letter to the Commiſſioners, writes thus: “ But before I proceed, I beg leave to offer my Opinion
“ of the old Foundations. Was the Bridge to be rebuilt of the
“ ſame Width it is at preſent, there would be great Reaſon to
“ uſe the ſame Foundations; but as it is to be ſo much wider, of
“ Conſequence the Piers muſt be lengthened; and I humbly
“ apprehend the Difficulty and Expence attending this additional
“ Lengthening will be greater than is generally imagin'd, and
“ the Difference of Expence between entire new Piers and this
“ Scheme of PATCHING, leſs than believ'd. Beſides it will be
“ attended with this ill Conſequence: The *old* and *new* Work
“ can never be ſo united but the one muſt ſettle from the other,
“ and a Settlement in the Foundation muſt be very fatal; every
“ Day's Experience ſhews Workmen the Truth of this Fact;
“ and I will appeal to every Man of Reaſon, whether it is not
“ imprudent, and contrary to public Intereſt, even to run the
“ Riſk of ſuch a Settlement. Beſides, when the old Piers come
“ to be taken down, I greatly fear, from the Thickneſs of them,
“ that they will be found only a Caſing filled with rubble Work;
“ and if ſo, the Water will get into them, and they will become
“ ſo rotten, that I am ſure I muſt appear very ignorant if I did
“ not diſſuade you from making Uſe of them.”

And Mr. *Stratford* tells us in Page 10 of his Letter, that
“ The Conſequence of opening the old Piers may be very ruinous
“ to them, as, probably the Inſide of the Piers are not at preſent
“ affected by the circumambient Water, though immerſed twice
“ in every twenty-four Hours: But, when they are opened, and
“ the Water paſs freely over them, it may occaſion the inſide Mor-
“ tar to diſſolve and decay, which of Courſe muſt affect the old
“ Foundations, and make it too precarious to venture a new
“ Building thereon, with any Probability of Succeſs, but ſuppoſing
“ the Caſe in a more favourable Light, there is another Difficulty
“ ariſes of more Conſequence than any before mentioned, and
“ that is, the Want of ſufficient Baſis or Ground-Plan, to contain
“ the Foundation of the propoſed new Arches. The Plan of
“ the old Piers, 'tis true, are ſufficient in Breadth to admit of
“ new Arches; but then, they want an Addition to the Length.
“ Now

culties that muſt attend the making Uſe of the old Foundations, whilſt Mr. *Bridges* without making the leaſt Doubt of lengthening the old Piers, or the Danger of opening them, has given us no leſs than FIVE Deſigns to be executed on them.

It is to be hoped therefore that the Commiſſioners will pay ſome Regard to the Opinion of two Men; one of whom from his Infancy was bred an Engineer, and who has had great Experience in that Science. The other, with allowed good Genius, has had the Advantage of a liberal Education, and the Inſtruction and Experience of one of the moſt celebrated Architects of his Time, I mean his Father.

I ſay, I hope their Opinion will be preferred before that of Mr. *Bridges*, whoſe Education as a Carpenter and Joiner, and whoſe well known travelling Employment neither entitle him to equal Authority, in Matters of Science, with thoſe Gentlemen, nor even give him a Claim to the Stile of ARCHITECT.

Mr.

" Now, to attempt to add new Maſon-work to the old Piers, " will be a Taſk not ſo eaſily executed as may be ſuppoſed ; be- " cauſe, Experience teaches us the Difficulty there is even of " joining a new Walling to a rocky and irregular Foundation, " in building the Walls of a Fortreſs though upon dry Land, " without having Sets and Chaſms ; but it will be found to be " much more difficult and precarious to be attempted under " Water, as it muſt be in the preſent Caſe."

Mr. *Bridges*'s Letters and Deſigns now come under Conſideration. In the firſt Place, his Introduction is full of Flattery and Impertinence, unbecoming an Artiſt who offers his Plans to public Approbation. His *fifth* and *ſixth* Pages put me in mind of the following Lines of *Butler*.

He could raiſe Scruples dark and nice,
And after ſolve them in a Trice,
As if Divinity had catch'd
The Itch, on Purpoſe to be ſcratch'd.

And indeed all his Obſervations throughout his Letters; all his curious Contrivances to prevent what would never happen; and his Deſcriptions and Models of Machines for the Execution of the Work, are ſo puerile, ſo well known, and of ſo little Conſequence to the main Deſign, that I look on all, together with his numerous Plagiariſms, as ſo many Inſults on the Judgement of the Commiſſioners and Public: His oſtentatious comparing his ſeveral Deſigns to others in foreign Countries, which probably he never ſaw, is as ridiculous a Piece of Arrogance as was ever ſeen: "What a falling off * (ſays he) would there "be, when compared with the former "Method, which would not fail to make "the *firſt* Deſign equal to that laſting Bridge "over the *Bachilione* at *Vicenza*.

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* Mr. *Bridges*'s Letter, P. 49.

“ The *Second*, to ſurpaſs the new Bridge of
“ *Compeigne* over the *Oiſe*.

“ The *Third*, to vie with the fam'd *Senatorian* Bridge of ancient *Rome*.

“ And the *Fourth*, no Way inferior to that
“ Maſter-Piece of Art, the *Rialto*, over the
“ great Canal at *Venice*.”

Theſe Deſigns ſhall be examined in the Order they were offered to the Public, and,

FIRST, *His Deſign of a Bridge with* THREE SEMICIRCULAR *Arches on the* OLD *Foundations*.

How Mr. *Bridges* can compare this Deſign to that over the *Bacchiglione* at *Vicenza* is a little ſurpriſing; as the *latter* has not only all the Arches ſmaller, but they are alſo[*] *Segments* of Circles, riſing one third of their Chord; whilſt thoſe of Mr. *Bridges* are all *Semicircles* and are divided in the following Manner.

[†] The Center Arch - - - - -	45 *Feet*.
The Piers each 9 *Feet* - - -	18
The Side Arches each 37 *Feet*	74
In all	137 *Feet*.

In the preſent old Bridge, the Arches and Piers are as follow[‡]:

	Feet.	*Inches*.
The *Redcliff* Arch - - -	24	0
The *Redcliff* Pier - - - -	24	8
The *Lighterman's* Arch - -	26	0
The *Chapel* Pillar - - -	35	4
The *Chapel* Arch - - -	26	0
In all	136	0

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[*] *Palladio*, Lib. 3. C. 12.

[†] Mr. *B*'s Let. P. 8.

[‡] Ib. P. 34.

Theſe Dimenſions of the old Bridge are thus *one Foot* leſs than Mr. *Bridges's* Deſign, and conſequently, (as he propoſes to fill up the St. *Nicholas* Arch) the Face of his *South* Abutment will fall *ſix Inches* within the Face of the *Redcliff* Abutment; and the Face of his *North* Abutment will fall *ſix Inches* within the *South* Face of the St. *Nicholas* Pier; which Face, as alſo that of *Redcliff* Abutment now meaſure about *nineteen Feet*, that is, *twenty-five Feet* leſs than *forty-four Feet*, the intended Width * of Mr. *Bridges's* Deſign; and conſequently lengthening will in this Caſe be required.

Again, according to Mr. *Bridges's* Deſign,

His *Redcliff* Arch will be - -	37 *Feet.*
His *Redcliff* Pillar will be - -	9
In all	46 *Feet.*

But in the preſent Bridge,

	Feet.	*Inches.*
The *Redcliff* Arch is - - -	24 :	0
The *Redcliff* Pillar is - - -	24 :	8
In all	48 :	8

Now as Mr. *Bridges's Redcliff* Arch ſprings *ſix Inches* within the preſent *Redcliff* Abutment, of Conſequence the *North* Face of his *Redcliff* Pier will fall *three Feet two Inches* within the *North* Face of the preſent *Redcliff* Pier, which cannot increaſe that Face above *ſix Feet*; ſtill *nineteen Feet* ſhort of *forty-four Feet*, ſo that lengthening is here alſo neceſſary.

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* Mr. *Bridges's* Letter, Page 46

This will appear yet more plain by inſpecting *Plate* I; where the *dotted* Lines repreſent the Plans of the *old* Piers and Arches; and the *whole* Lines, Mr. *Bridges*'s Arches and Piers; and it is here evident how much of theſe *new* Piers are unſupported by the *old* ones; and that a Bridge, of the Dimenſions Mr. *Bridges* propoſes his, cannot be executed on the preſent *old* Foundations without lengthening them; the Danger and Difficulty of ſuch an Undertaking amount almoſt to an Impracticability from what Mr. *Stratford* and Mr. *Wood* have ſaid on that Subject.

From the ſeveral Borings Mr. *Bridges* by order of the Commiſſioners has made, it is very reaſonable to ſuppoſe, that the preſent *old* Piers are founded *twenty-one* Feet below the Bed of the River; a Circumſtance that ſtrengthens Mr. *Stratford*'s and Mr. *Wood*'s Opinions of the Danger of uſing them; and as Mr. *Bridges*'s *new Piers* cover ſo little of the *old ones*, how in the Name of Wonder does he intend, or has he propos'd to prevent the Water getting into them, and cauſing that Ruin which both Mr. *Stratford* and Mr. *Wood* have foretold? Nay, ſo far from even thinking on ſo material a Circumſtance, that he has propoſed * to put a Timber-grating under his *new* Piers on the *old* Foundations; and has taken great Pains to model and explain the Method of building in Caiſſons, (which, by the by, is copied from Mr. *Labelye)* intending to uſe them in building his Piers on the *old* Foundations, which is an Abſurdity no Man of common Experience would be guilty of; and I refer the Reader to what Mr. *Muller* ſays † on this Head, to be convinced of the Truth of what I aſſert.

This Abſurdity is *great*, ſuppoſing the *whole* of the *new* Pier to be ſupported by the *old* one; but it is ſtill *greater*, as this Grating muſt reſt partly on the ſolid, and at leaſt *twelve Feet* at each End project over, and become nothing but a weak Truſs, that can never ſupport the incumbent Weight. The By-ſtander ſhews very little Knowledge, and great Partiality in declaring this Method preferable to that, propoſed by Mr. *Wood* to encreaſe the Width of the Bridge. Mr. *Wood*'s Method the By-ſtander is pleaſed to call § expenſive and diſagreeable; but I will explain it in Mr. *Wood*'s own Words, and leave it to the Determination of the judicious Reader, whether it is ſo or no.

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* Mr. *B.* Letter, Page 10.

† *Muller*'s Pract. Fortif. Part 4. Sect. 2. § By-ſtander, P. 36.

Mr *Wood* tells us that the Face of a new Pier, built directly in the Center || of the preſent *Redcliff* Pillar, will not exceed *thirty-four Feet*, and then ſays as follows. " Now ¶ as the " Arch is but *thirty-four Feet* wide, it will " be inſufficient for a Road over it, unleſs the " following Invention be approved of; which " I am convinced will fully anſwer the Pur-" poſe: Allot *twenty-ſeven Feet* for the Car-" riage Road, and there will remain *three* " *Feet ſix Inches* on each Side; then truſs " over on each Side *three Feet ſix Inches* in the " Manner I have drawn it; (ſee *Plate* II. " *Fig.* 1.) by which Means there will be " Room for a Foot-path *ſix Feet* wide on " each Side, and a Stone Plinth with a neat " ſtrong Iron Rail along it. In *Plate* II. I have " endeavoured to expreſs the Method of " making and ſetting theſe Truſſes in the " ſtrongeſt Manner poſſible; they are to be " *one Foot* in Front, *three Feet* deep, and " *ſeven Feet* long, half of which will have " a Bearing on the Front of the Bridge, as " repreſented by *Fig.* 1. Theſe Truſſes are " to be *three Feet* aſſunder, and covered from " Center to Center with flat *Portland* Stones, " *four Feet* long and *ſix Inches* thick, which " Stone is again to be covered with the com-" mon Pennant of the Country. *Fig.* 2. " repreſents the Front of theſe Truſſes, to-" gether

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|| Mr. *Wood's* Second Letter, Page 8. ¶ Ibid, P. 10.

“ gether with the plinth Courſe, and Part of
“ the Iron Rail upon it, drawn to a larger Scale.
“ Now to prevent theſe Truſſes from tipping
“ forward, I would have all that Part of
“ them that reſts on the Bridge to be *joggled*
“ from Top to Bottom, as *Fig.* 3; by which
“ Means they will become inverted Wedges;
“ and if large Blocks of Stone, of *three Feet*
“ Bed and *three Feet* deep, be placed between
“ them Wedge-wiſe, and a Bar of Iron let
“ into them horizontally, as repreſented in
“ *Fig.* 4. and well yeoted with Lead, the
“ whole will become ſo firm, that no Weight
“ on the Noſe of the Truſſes can ever poſſibly
“ overſet them; but to be certain, I would
“ have a *Chain-courſe* of Stone run the whole
“ Length of the Bridge, juſt under the Tails
“ of theſe Truſſes, which may be cramped
“ to them as in *Fig.* 4.”

To obviate the Danger of the Water's getting into the *old* Foundations when the Piers are taken down, Mr. *Wood* propoſes to take down the *old* Piers only to low Water-mark, and then to cope them with an *eighteen Inch* Courſe of Stone, well jointed, ſet in Terras, and cramped; which will not only prevent the Water getting in, but will band the whole Foundation together, that with Safety it may be built on, without the Trouble and unneceſſary Expence of *Caiſſons* or *Timber Gratings*; it being very apparent that there is no Occaſion, nay that it is improper, to pull down the *old* Piers below low Water.

Before I return to the Examination of Mr. *Bridges's* Deſign, it will not be improper to point out that Gentleman's Plagiariſms, and to animadvert on them. The firſt I ſhall take Notice of is from *Batty Langley*'s Letter to the Commiſſioners for building *Weſtminſter* Bridge, printed in the Year 1736.

Mr. *Bridges* in his firſt Letter to the Commiſſioners for rebuilding *Briſtol* Bridge, Page 9, writes thus.	Mr. *Langley* in his Letter, Page 21, writes thus:
All Kinds of regular Arches being equally preſſed, will ſuſtain the greateſt Weights; but if one Side of a regular Arch be preſſed much more than the other (which is always the Caſe when Arches differ ſo much as theſe do) the Curve in Time will ſooner change, its Form become rampart, and fall down. As was the Fate of a large Stone Bridge about the Year 1710, built upon this Principle, over the River *Allier* at the Town of *Moulins*, in *Provence*, in *France*, called the *Bourbonois*.	All Kinds of regular Arches being equally preſſed will ſuſtain the greateſt Weights; but if one Side of a regular Arch be preſſed much more than the other, the Curve will change its Form, become rampart, and fall down.
Now to prevent this unequal Preſſure as well as to abate the great Thruſt of the Arches againſt their own Abutments, as alſo to leſſen the Weight on the old Foundation. I propoſe *A concave horizontal Cylinder*, in each Spandrel, each Pier and in each Abutment, which are re-	Now to prevent this unequal Preſſure as well as to abate the great Thruſt of the Arches againſt their own Abutments, I have contrived the making of *concave horizontal Cyilnders*, in each Spandrel and in each Pier alſo, which are repreſented by the dotted Circles to be continued

repreſented by the dotted Circles to be continued quite thro' the whole Thickneſs of the Bridge, the out Walls only excepted; by Means of which the Weight of each Spandrel will not only be greatly abated, but by making the Cylinders in the upper Spandrels proportionably larger than the Cylinders in the lower Spandrels, their Preſſures will be equal, and therefore free from the Danger of the unequal Preſſure aforeſaid.

tinued quite through the whole Thickneſs of the Bridge, out Walls only excepted; by Means of which the Weight of each Spandrel will not only be greatly abated, but by making the Cylinders in the upper Spandrels proportionably larger than the Cylinders in the lower Spandrels, their Preſſure will be equal and therefore free from the Danger of unequal Preſſure as aforeſaid.

The little Uſe of theſe Cylinders is fully pointed out by the late Mr. *James*, of *Greenwich*, in his Review of the Deſigns offered for *Weſtminſter* Bridge, publiſhed in the Year 1736. I ſhall therefore at preſent take no farther Notice of them, but only obſerve,

Firſt, That it is cruel in Mr. *Bridges* to attempt to rob *Batty Langley* of the Honour of a uſeleſs Invention; and he certainly ſhould have been ſo candid, as to have told us from whom he had borrowed ſo curious a Thought.

Secondly, That Mr. *Bridges* is very unfortunate in his Example of the Bridge over the *Allier*; by which, he has expoſed both his Knowledge in Architecture, and his Skill in Geography. For, from his Deſcription of the Bridge, one cannot but conclude, that its Name is the *Bourbonois*, and that it is built over the *Allier* in *Provence*; whereas in Fact, the River *Allier* is in a Province of *France* called

Bourbonois, in the weſtern Government of *Lionois*, and not in *Provence*, which is itſelf a conſiderable Government.

And the Ruin of this Bridge was not owing to the Inequality of its Arches, but to its bad Foundation, and to its being built * on Stilts, as we learn from Mr. *Labelye* in his Deſcription of *Weſtminſter* Bridge; which Book it is very plain Mr. *Bridges* has read, from his ſeveral Plagiariſms from it, and therefore it is ſurpriſing. that he ſhould attribute the Ruin of the Bridge over the *Allier* to a Cauſe different to that, which Mr. *Labelye* demonſtrates was a real one.

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* Mr. *Labelye* in his Deſcription of *Weſtminſter* Bridge, after briefly exploding the Method of building on Stilts ſpeaks thus : " All this is founded on Reaſon and Geometry, and what is dictated by Reaſon and Geometry is generally confirmed by Experiments, of which an Inſtance happened not many Years ago, for the Knowledge of which I am obliged to the late General *Wade*, in whoſe Hands were the Deſigns taken upon the Place. About the Year 1710 ſome *French* Engineers attempted to build a Stone Bridge over the River *Allier*, at the Town of *Moulins*, in a Province of *France*, called the *Bourbonois*: The intended Bridge conſiſted of three large eliptical Arches, ſupported by the two Abutments, and two Piers, whoſe Breadths were each about 1-4th of the Span of the Middle Arch; the whole Deſign in a very bold Taſte.

" They placed the Stone Work on the Tops of a very great Number of large Piles, extending in Surface about *ſix Feet* all round the outſide of the Stone Work. Their Piles were driven about *fifteen Feet* deep in the Bed of the River, the Tops of them were ſtrongly faſtened together, and reached about *five* or *ſix Feet* above the Surface of the Bed of the River; but the Moment they attempted to eaſe the Centers on which they turned the Arches, the whole Fell into Ruin. See *Labelye*'s Deſcription of *Weſtminſter* Bridge, Page 47."

The ſecond Plagiariſm is from a little anonymous Pamphlet, entitled, *The preſent State of Weſtminſter Bridge*, printed in the Year 1743.

Mr. *Bridges*, in his firſt Letter to the Commiſſioners, P. 50 writes thus:	In the 8th Page of the above named Pamphlet, it is thus written:
Over the firſt Arch may be turned another, two or three Times thicker at the Reins than over the Key, ſo calculated and built, that by the Help of this ſecondary Arch, together with the incumbent Load of Materials, all the Parts of every Arch will be in *Equilibrio*, that is to ſay, the *Thruſt or lateral Preſſure*, which all Arches have more or leſs, according to their Figure and Conſtruction exert to overſet their Piers, will, by a proper Diſpoſition of the Materials, be entirely counterballanced and deſtroyed; ſo that each Arch thus built will ſtand ſingle without affecting or being affected by each other.	The Soffit of every Arch is turned and built quite through, the ſame as in the Fronts, with large *Portland* Blocks; over which is built (bonded in with the *Portland*) another Arch of Purbeck Stone, four or five Times thicker on the Reins than over the Key, ſo calculated and built, that by the Help of this ſecondary Arch, together with the incumbent Load of Materials, (but not without that Load) all the Parts of every Arch are in *Equilibrio*; that is to ſay, the *Thruſt* or *lateral Preſſure* which all Arches, built in the common Way, do more or leſs according to their Figure and Conſtruction, exert to overſet their Piers, is, by a proper Diſpoſition of the Materials entirely counterballanced and deſtroyed; ſo that each Arch of *Weſtminſter* Bridge after it is built, could ſtand ſingly, without affecting, or being affected by any of the other Arches.

Theſe Counter-arches are the Thought of Mr. *Labelye*, and by him executed in *Weſtminſter* Bridge; whether the Effect of them is ſuch as he repreſents, is not now to be diſputed; but I am afraid he argues on wrong Principles. To the above-mentioned little Pamphlet Mr. *Bridges* is indebted for a great many Thoughts that he has copied almoſt verbatim, and which it would be too tedious here to recapitulate: What I have already ſhewn is ſufficient to prove the Plagiary, and what the By-ſtander unjuſtly ſays of Mr. *Stratford,* may be aptly ſpoken of Mr. *Bridges*; "This Gentleman [*] when he ſat down to invent, had ſome Ideas of producing a Thing ſtriking and magnificent; but the Manner in which he has done it is rather *imitative*." This is farther demonſtrable in the *third* Plagiariſm I ſhall take Notice of, which is from Mr. *Labelye*.

Mr. *Bridges* in deſcribing the Models of his *three Arch* Bridge, Page 43, ſays thus:	Mr. *Labelye* in his Deſcription of *Weſtminſter* Bridge, Page 23, ſays thus:
The Piers to terminate at the ſalient Angles in a right one, and over the Point, on each End of the Pier, is a ſemi-octagonal ruſticated Bow, which may in ſo ſhort a Bridge as this be omitted; but for the following Reaſons I have here introduced them, in Order in the firſt Place, to have the Points and the Middle of the Piers as equally loaded as poſſible, which will contribute to the Security of the whole.	Over each Point or ſalient Angle of each of the Piers, there is a ſemi-octagonal ruſticated Turret, built with Stone, for the following Reaſons; in Order in the firſt Place to have the Points and the Middle of the Piers as equally loaded as poſſible, which will contribute to the Security of the whole.

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[*] By-ſtander's Letter, Page 23.

Secondly, To ſtrengthen the Arches by oppoſing ſo much more Weight or Reſiſtance againſt their *Thruſt* or *lateral Preſſure*; for it is very demonſtrable, that the lighter an Arch is in Proportion to its Piers, (or what comes to the ſame) the heavier the Piers are in Proportion to the Arch, the firmer the Arch will be; and the contrary vulgar Opinion, viz. *That the more an Arch is loaded the ſtronger it will be*, is a groſs Error.

Thirdly, Theſe ruſticated Bows, beſides the real Advantages already mentioned, do very much add to the Decoration of the Fronts of the Bridge, by dividing or breaking a ſtrait Line the Length of the Bridge into as many Parts as there is Arches.

Fourthly, becauſe theſe Bows being carried quite up the block Cornice, and Parapet Walls, &c. made to follow their out Line, will afford uſeful and commodious Receſſes for the Foot Paſſengers, where they may retreat, if any Buſineſs or Accident require their ſtopping, without embarraſſing the Foot-way, as it too often happens in the Streets.

Secondly, To ſtrengthen the Arches by oppoſing ſo much more Weight or Reſiſtance againſt their Thruſt *or lateral Preſſure*; for it is very demonſtrable, that the lighter an Arch is in Proportion to its Piers, or (what comes to the ſame) the heavier the Piers are in Proportion to the Arch, the firmer the Arch will be; and the contrary vulgar Opinion, viz. *That the more an Arch is loaded the ſtronger it will be*, is a groſs Error, as may eaſily be ſhewn.

Thirdly, Theſe ruſticated Turrets, beſides the real Advantages already mentioned, do very much add to the Decoration of the Fronts of the Bridge, by dividing or breaking ſo long a Line as the whole Length of this Bridge into as many Parts as there are Arches.

Fourthly, Becauſe theſe Turrets being carried quite up, and the ruſtic Cornice and the Parapet Walls made to follow their out Line will afford uſeful and commodious Receſſes for Foot Paſſengers, where they may retreat if any Buſineſs or Accident require their ſtopping, without embarraſſing the Footway, as it too often happens in the Streets.

If a Man is reſolved to be a Plagiary, he ought at leaſt to underſtand the Authors whoſe Thoughts he copies, and not to copy them at Random; as is certainly the Caſe with Mr. *Bridges*; who appears, not to know what the *lateral Preſſure* of an Arch means, as every one muſt conclude, who will be at the Trouble to compare theſe three Plagiariſms together; for, the *horizontal Cylinders*, the *counter Arches*, and the *ruſticated Bows* are propoſed to effect the ſame Thing, when at the ſame Time they operate on quite different Principles; the one takes off the Weight, the other puts it on again.

Theſe Receſſes may indeed be of Uſe in a Bridge ſo *long* as that at *Weſtminſter*, which meaſures 417 Yards, but are not quite ſo proper in *Briſtol* Bridge, whoſe Length is not much above *one ſeventh* Part of that Meaſure. The Impropriety of theſe Receſſes, in Mr. *Stratford*'s Plan, could be taken Notice of by the By-ſtander, whoſe Opinion of them is as applicable to Mr. *Bridges*, as to Mr. *Stratford*; "They are all good in themſelves (ſays "the By-ſtander*) but applied here in that "Tower-like Manner are very improper in "a Bridge of three ſuch ſmall Arches; all "theſe Materials and Workmanſhip is † expended to ſupport a Receſs that will probably preſerve a continual Smell, and a very "diſagreeable Sight to all that paſſes over "the Bridge.

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* By-ſtander's Letter, Page 13.

† As I have copied the By-ſtander verbatim, pray do do not attribute that learned Author's falſe Engliſh and falſe Grammar to me.

Theſe Turrets are by Mr. *Labelye*, with great Propriety, introduced to break ſo *long* a Line, as the whole Length of *Weſtminſter* Bridge; but the Effect will be very oppoſite in ſo *ſhort* a Bridge as that of *Briſtol*, eſpecially as a *ſtrait*, not a *long* Line is propoſed to be broke by them.

Mr. *Bridges*, in the 51ſt Page of his Letter, ſpeaking of the Counter-arches, and the Manner of filling the Spandrels with Work, the Joints of which are to preſerve a Tendency to the Center, ſays thus: "This Manner of "filling the Spandrels of the Arches is infi-"nitely preferable to the common Way; "which is, *to fill what is above the Arch-"Stones in the Fronts with horizontal Courſes, "and to fill all the Inſide with Rubble laid at "Random.* It is ſurpriſing that this Man-"ner of Arching has not been put in "Practice ſo often as it might. However I "will mention a few Examples, where the "ſame good Precaution has been obſerved: "The great Arch at *Venice* 98 *Feet* ſpan; "the great Arch at *Vicenza* 110 *Feet* ſpan; "a Groin Arch at *Blenheim* built in this "Manner, which ſtands firm and well, tho' "it has only *three* and a *Half Feet* Riſe, "upon a *forty-four Feet* Span; and all the "Arches of the *Pont-Royal* at *Paris*, ſo "much cried up by the *French*, and ſo juſtly "praiſed on this Account."

Whoever reads the above Paragraph will naturally conclude, that the Obſervations in it are Mr. *Bridges*'s own; I am ſorry that they are not, and that I muſt declare, the whole Paragraph to be copied *verbatim* from * Mr. *Labelye.*

I cannot more properly than in this Place point out ſome few petit Plagiariſms of Mr. *Bridges*, who in the 31ſt Page of his Letter ſays thus: " Beſides the *Vouſſoirs* or *Arch-* " *Stones* in each Front could then have proper " *chamfered Joints*, which may be continued " quite through, under the *Soffeit* of the " Arches; becauſe Experience ſhews this " ruſtic Decoration of the Archivolt of the " Arches to have a very good Effect (in large " Works on the Water eſpecially) and the " *chamfering* the Joints hinders the fluſhing " and breaking of the Edges of the Stone." And in Page 50 of his Letter he gives a ſixth Reaſon why his Method of building the Bridge will be ſolid in the following Words, viz. " To provide for their future Security by " proper Drains; ſome Bridges have been " ruined for Want of this neceſſary Precau- " tion which ſhould be obſerved in all con- " ſiderable Bridges, and yet it is to be found " in very few." Theſe two ingenious Thoughts I did attribute to Mr. *Bridges*'s *good* † *mechanical*

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* *Labelye*'s Letter, Page 23.

† A Term made Uſe of by the By-ſtander, Page 37.

nical Head, 'till ſuch Time I ſaw them in Mr. *Labelye*'s * Letter, from which Mr. *Bridges* has tranſcribed them Word for Word; and I can only ſay that I wiſh all his other Plagiariſms were as well adapted as theſe.

In the 48th Page of his Letter Mr. *Bridges*, ſpeaking of a cheap Method of building the Bridge, tells us, that " the Maſonry between " and over the Chain-courſes and Inſide of the " Spandrels may be filled with the following " Compoſition, that is *twelve Parts* of Ter- " ras, *ſix* of large grained Sand, *nine* of un- " ſlacked Lime, *fifteen* of Stone Splinters, " (about the Size of an Egg) and *three Parts* " of Glaſs-houſe Cinders." This Compoſition is taken verbatim from † Mr. *Muller*; but I wiſh Mr. *Bridges* had introduced it with the ſame Modeſty that Gentleman has done; not as his *own* Invention, but as a Method made Uſe of by the *French* Engineers. I muſt however obſerve that Mr. *Bridges* greatly miſunderſtands the Uſe of this Compoſition; which is to be uſed under Water, to make a Foundation where the *Batterdeaux* and the *Caiſſons* are not proper. In the Manner Mr. *Bridges* propoſes to uſe it, it will not anſwer, and I may venture to affirm that it is a much *dearer*, and a leſs *ſolid* Method than filling the Spandrels with good rough Maſon's Work.

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* *Labelye*, Page 21 and 22.

† *Muller*'s Practical Fortification, Page 270.

The next Plagiariſm, I ſhall take Notice of, is that Section of Mr. *Bridges*'s Letter, which he calls,

"*The Reſult of a Calculation made on the "obſtructed Water occaſioned by the great Bulk "of the old Piers, &c.*

Mr. *Bridges* writes thus:	Mr. *Langley* begins his Letter to the Commiſſioners for building *Weſtminſter* Bridge thus:
Many has wondered, and many are ſtill doubful, whether the *three* Arches thus erected on the old Foundations will admit of ſo much Water Way as the preſent *four* Arches.	*My Lords and Gentlemen,*
It appears by a Meaſurement taken at *Briſtol* Bridge, that the Breadth is 185 Feet, Depth in the Channel, at the higheſt Spring Tide, 28 Feet, and at low Water 5 Feet, the mean Depth of which is 16 Feet and a Half.	It appears by a Meaſurement of the River *Thames* made at the Horſe-Ferry againſt *Lambeth*, that its Breadth at the Times of low Water is 700 Feet, and Depth in the Channel 11 Feet, and therefore I ſhall eſtimate the River's mean Depth at thoſe Times at 5 Feet and a Half.
If 185 the Breadth be multiplied by 16 and a Half Feet, the Product will be 3052 Feet 5-16ths, which is the Number of cubical Feet of Water, advancing at ſuch Times forwards by the Velocity of the Current. *	If 700 its then Breadth, be multiplied by 5 and a Half, the Product is 3850, which are the Number of cubical Feet of Water advancing at ſuch Times forwards by the Velocity of the Current. *
If	If

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* The Abſurdity of this Poſition muſt appear plain to every one who will conſider, that a *Length* multiplied by a *Breadth* can never give a *cubical* Product; and that the Quantity of Water advancing in a River is determined by the Velocity or Strength of the Stream.

If by Impediment, any of theſe 3052 5-16ths cubical Feet of Water be obſtructed in their natural Courſe, the Feet ſo obſtructed will raiſe themſelves upon the Surface of the Water, whoſe Courſe is free; for as there is a conſtant Succeſſion of Water, the obſtructed Water muſt paſs away over the free Water, in the ſame Time.	If by Impediment, any of theſe 3850 cubical Feet of Water be obſtructed in their natural Courſe, the Feet ſo obſtructed will raiſe themſelves upon the Surface of the Water, whoſe Courſe is free; for as there is a conſtant Succeſſion of Water, the obſtructed Water muſt paſs away over the free Water, in the ſame Time.
On *Friday* the ſecond of March 1759, by Order of the Committee, I obſerved that the obſtructed Water, raiſed upon the free Water (at Half Ebb) when it paſſed by the Impediments made a Fall of about 16 Inches which is a great Increaſe, particularly to the Velocity of the ebbing Tide, and much greater at firſt Quarter of Ebb (owing to the Form of the Arches, which are gothic.)	It is the Deſcent of the obſtructed Water raiſed on the free Water, when paſſed by the Impediments, that is the Fall, and which is greater or leſſer according to the Quantity of the Impediment.
Hence it is that when the Water of a River hath ſome of * its Parts obſtructed, the Depth is encreaſed by ſo much as the obſtructed Water riſes to; and on the other Hand when the Breadth of a River increaſes more and more wide, the Depth of the Water is diminiſhed, the ſame Quantity of Water being ſpread over a larger Surface, which Diminution is always in Proportion to the River's Breadth.	Hence it is that when the Water of a River hath ſome of * its Parts obſtructed, the Depth is encreaſed by ſo much as the obſtructed Water riſes to; and on the other Hand when the Breadth of a River encreaſes more and more wide, the Depth of the Water is dimininiſhed, the ſame Quantity of Water being ſpread over a larger Surface, which Diminution is always in Proportion to the River's Breadth.

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* This Conſequence as deduced by Mr. *Langley* has ſome Degree of Probability, but I cannot ſee how Mr. *Bridges* could deduce it from what he himſelf has before advanced.

Thus far Mr. *Bridges* has been a cloſe Copier of Mr. *Langley*, he then proceeds thus: “ I have further endeavoured to anſwer this *Quære* as it's of material Conſequence to the Navigation, and muſt in a Manner decide the Choice of the ſeveral Plans now offered; and this by an exact Menſuration of all the Voids and Solids of the preſent Bridge, as it now ſtands; and alſo the firſt Deſign of three ſemicircular Arches on the old Foundation, *viz.*

Of the Old Bridge.	*Feet.*	*Inch.*	*Of the New Bridge.*	*Feet.*	*Inch.*
Redcliff Arch - -	24	0	Redcliff Arch - -	37	0
Lighterman's Do. -	26	0	Center Do. - -	45	0
Chapel Do. - -	26	0	St. Nicholas's Do. -	37	0
St. Nicholas's Do. -	22	6			
Sum of Voids	98	6	Sum of Voids	119	0
Redcliff Pillar - -	24	8	Redcliff Pier - -	9	0
Chapel Do. - -	35	4	St. Nicholas's Do. -	9	0
St. Nicholas's Do -	26	6	New Key-walls - -	48	0
Solids	86	6		66	0
River's Breadth	185	0	River's Breadth	185	0

“ Now the Sum of the Voids of the old Bridge is 98 Feet 6 Inches, which multiplied the mean Depth 16 Feet ſix Inches, the Product is 1625 cubical Feet and three Inches, the true Water Way running thro' the Bridge at that Time.

“ The Sum of the Voids of the new Bridge is 119 *Feet*, which muſt alſo be multiplied by the mean Depth 16 ½ *Feet*, the Product is 1963 *Feet* 6 *Inches**; therefore deduct the cubical *Feet* in the Voids of the *old* Bridge, from the Voids of the *new* Bridge, and the Difference is 338 cubical *Feet* 3 *Inches* in favour of the *new* Bridge, which is an Addition of more than *one fifth*, and equal to the Difference of the Water obſtructed by the *old* Pillars.

“ This Impediment† being thus removed, will prevent the ebbing and flowing of the Tide with its uſual Velocity, as above a *fifth* more Water will paſs through the Arches in the ſame Space of Time, with greater Freedom; and this more ſo in my other Deſigns, to the no ſmall Improvement of the Navigation.

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* By theſe Calculations Mr. *Bridges* appears to know very little either of Arithmetick, or of Geometry, for the Numbers multiplied together as he has done, produce not *cubical* but *ſuperficial* Feet, as every School-boy will tell him; tho' he calls to his Aid, to ſhew the contrary, all that Chicanerie and Sophiſtry, he has already made Uſe of to prove, That the *leſſer* will contain the *greater*; and that an Arch of 96 will meaſure 137 *Degrees*. And I muſt beg Leave to tell him, that neither 185, nor 98 Feet 6 Inches, not 129 multiplied by 16 ½, will give the Products he has mentioned.

† What Impediment?

“ Thus, Gentlemen, I have endeavoured “ to prove[‡], that whenever any Part of the “ Water of a River is obſtructed, ſuch “ Water will flow or raiſe itſelf on the free “ Water, up the River, until it hath gained “ a Paſſage over the free Water, equal to its “ own Obſtruction; and therefore the leſs “ ſuch Obſtruction is, the leſs Height will “ the obſtructed Water be raiſed to, and “ conſequently the leſs will be its Fall, after “ having paſſed ſuch Impediments.”

Thus abruptly and unſatisfactory ends this, I may ſay, unintelligible Section; its Meaning would puzzle even Mr. *Bridges* himſelf to explain; and how he can call it, *The Reſult of a Calculation*, I really am at a Loſs to diſcover, as with equal Propriety he might have called it *The Hiſtory of Tom Thumb*; nor can there be any Thing more collected from it, than that *three* Arches that open 119 *Feet*, are larger than *four* that open only 98 *Feet* 9 *Inches*; this is ſufficiently plain, and Mr. *Bridges* might have ſaved himſelf the Trouble of his elaborate Multiplication; for he muſt know, or he knows very little of Arithmetic, that if any

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[‡] By what Arguments Mr. *Bridges* has proved what is advanced in this Paragraph, wants Explanation; but I muſt obſerve that the Paragraph from the Words *Whenver any Part, &c.* is a Copy of Mr. *Langley*, who introduces it in the 9th Page of his Letter, as a *Datum*, and not as a *Concluſion* from any Thing he had before ſaid.

Numbers, which bear a certain Proportion one to another, be multiplied by one and the ſame Number, the Products will ſtill continue in the ſame Proportion.

From the Data in the Beginning of the Section, we had Reaſon to expect ſome Kind of Calculation of the Fall of Water at the ſeveral Periods of the Tide, both in the preſent, and in the new Bridge; and had Mr. *Bridges* followed Mr. *Langley* a little further, he would have told us, that the Sum of the Voids, multiplied by the mean Depth, would have given the Quantity of Water freely paſſing through the Arches; and that the Sum of the Solids multiplied by the ſame mean Depth, would have given the Quantity of the obſtructed Water; which, by the 3d Datum in the above Section, would riſe itſelf on the free Water paſſing through the Arches: Now according to this Method of Calculation, the Fall of Water at *Briſtol* Bridge, on the 2d of *March*, 1759, ſhould have been at leaſt *twelve Feet*, inſtead of what it was, as Mr. *Bridges* obſerved it, *ſixteen Inches*. This Calculation probably Mr. *Bridges* made, and his finding its Conſequence differ ſo far from the Fact, may be admitted as an Excuſe for his not copying Mr. *Langley* any farther; but at the ſame Time it greatly impeaches both his Judgment and his Ingenuity: His Judgment; in that he copied an Author whoſe

Method of Argument he found falſe by Experience: His Ingenuity; in that, he would impoſe on us a Number of Maxims, which he knew would produce wrong Conſequences.

However abſurd Mr. *Langley*'s Method of calculating by a mean Depth may be, Mr. *Bridges* has encreaſed the Error; for the *Thames* being deep in the Channel, and quite ſhallow at the Water's Edge at Low-water, there is ſome Reaſon to eſtimate the Depth at a *mean* Meaſure; the Caſe is not ſo at *Briſtol*, where at High-water (the Time Mr. *Bridges* calculates) the Banks are almoſt perpendicular, and conſequently, near double the Water at that Time advancing forward than what he eſtimates.

This abſurd Method of calculating the Riſe of obſtructed Water is fully exploded by Mr. *James*, in the Pamphlet afore-mentioned, in which is the following Paragraph*, *viz.* "For in Arches of ſuch Extent as theſe (the "largeſt 120 *Feet*, the leaſt 80 *Feet)* Stones "of 3 *Feet* in Depth or Thickneſs will make "no Key, or have no Summering, as Work- "men call it; that is, the Backs of the Arch "Stones will ſo little exceed the under Sides "of them, that they will have no Wedge- "like Form to hang by." Now as Mr. *Bridges* has a Paragraph in † his Letter, expreſs'd

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[*] *James*'s Review, Page 47. † Mr. *B*'s Letter, Page 23.

preſs'd in the very ſame Words, it is not unreaſonable to ſuppoſe that Mr. *Bridges* has read Mr. *James*'s Pamphlet.

Mr. *Labelye* ‡ tells us, that from Numbers taken of the Voids and Solids of the new intended Bridge at *Weſtminſter*, and from Obſervations made on the Velocity of the Current, he computed the greateſt Fall that could ever happen under the Arches; this his Method of Computation, when applied to *London* Bridge, anſwered exactly; and is ſince proved true by the Event at *Weſtminſter* Bridge; and we are farther told, that this Method of Calculation was approved of by § Dr. *Deſaguliers*, and the learned Mr. *James Hodgſon*, Maſter of the Mathematical School at *Chriſt* Hoſpital.

Mr. *Bridges* having certainly read Mr. *Labelye*'s Letter, as well as Mr. *James*'s, it is ſurpriſing he ſhould pay no Regard to the

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‡ Mr. *Labelye* concludes the Account of his Calculation with theſe Words: " It is no Wonder the pretended Calculations of the Fall under *Weſtminſter* Bridge which have been publiſhed in ſeveral Pamphlets are all falſe, ſince the Authors never thought at all of, or enquired about the greateſt Velocity of the ebbing Waters, or had ever taken that Velocity (on which the Fall chiefly depends) into any of their Calculations; nay ſome of them were ſo entirely ignorant of the very firſt Principles on which thoſe Computations are founded, that they attempted very gravely, to compute and compare the Fall under *Weſtminſter* Bridge, that under *London* Bridge by the Rule of Three; by which alone, they might as well attempt to find the Moon's Age, or the preſent Value of the Reverſion of an Eſtate after two or three Lives." See *Labelye*'s Letter, Page 9.

§ See *Labelye*'s Letter, 1ſt Edit. Page 12.

Opinion of two ſo eminent Perſons; but implicitly, follow an Author ſo notorious for his little Share, either of Knowledge, or Learning, as Mr. *Langley* was; eſpecially when his own Manner of Calculation proves itſelf to be falſe. I know of no other Reaſon to be given for it, than, either that Mr. *Bridges* knows as little of the Matter, as it is plain Mr. *Langley* did; or that he takes us all for mere *Bonifaces, who muſt conclude his Latin to be good, becauſe he talks it ſo faſt.*

The Deſcription Mr. *Bridges* gives of his Engine for driving the Piles, is ſo like to that which Mr. *Labelye* gives of the Engine made Uſe of at *Weſtminſter*, that I muſt tranſcribe both.

Mr. *Bridges*, Page 52, ſays thus:

Third Model is an *Engine for driving the Piles*, conſiſting of one upright Shaft, one Wheel, four Pullies, and one Weight, beſides the *Ram*; the whole framed together on a Lighter or Stage, and may be uſed by either Men or Horſes. This Method of driving Piles has been highly eſteemed; for which Reaſon it will be ſufficient for me only to mention, that, having calculated the Effect of this Engine, I found, that ſuppoſing the *Ram* to weigh 1200lb. and the Height of the Strokes at a mean 16

Feet

Mr. *Labelye*, Page 31, ſays thus:

The Method made Uſe of to drive the Piles, was contrived by the late Mr. *James Vauloüé*, a very ingenious Watchmaker of my Acquaintance, who has publiſhed a Print of the Engine, with an Explanation; for which Reaſon, it will be ſufficient for me to mention, that having viewed the Model of that Contrivance, and calculated the Effect of ſuch an Engine, I found, that ſuppoſing the Ram or Weight to be 1700lb. and the Height of the Strokes at a mean, 20 Feet perpendicular, the Engine

would

Feet perpendicular, the Engine would give about 26 Strokes per Hour by the Help of four Men, and about 48 Strokes per Hour by the Help of two Horſes. This Effect being much ſuperior to that of any of the Engines commonly uſed for that Purpoſe, was the chief Reaſon* that determined me to drive the Piles in this Manner: For tho' the Expence of this Engine will be conſiderably more than that of any other Sort, and will take up a great deal of Time in making; yet I know, if the *third Deſign* ſhould take Place, as alſo a *ſecond Bridge*, it will make us good Amends, by the Expedition and other Conveniencies, attending this Manner of driving Piles upon a floating Stage.

would give about 48 Strokes *per* Hour, by the Help of two Horſes, and about 70 Strokes *per* Hour, by the Help of three Horſes: This Effect being much ſuperior to that of any of the Engines commonly uſed for that Purpoſe, was the chief Reaſon* that determined me to drive the Piles in that Manner; for though the Expence of our Engine was conſiderably more than that of any other Sort, and though it took a great deal of Time in making, yet I knew it would make us Amends by the Expedition, and other Conveniencies attending this Manner of driving Piles upon a floating Stage.

This is evidently another Plagiariſm; and from it I cannot but obſerve, either that Mr. *Bridges* does not know how to make the Calculation he ſays he has made; or that his Engine is not ſo good as that made Uſe of by Mr *Labelye*; becauſe the latter, with the ſame Power, gave the ſame Number of Strokes in an Hour as Mr *Bridges*'s will, tho' the Weight is 500 Pounds heavier; and the Difference of the Height of the Strokes in each, is as 4 to 5 in Favour of Mr *Labelye*'s. That Mr

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** This Expreſſion is properly uſed by Mr. *Labelye*, but not quite ſo by Mr. *Bridges*, who ſhould have told us when and where he made Uſe of this Engine.

Labelye's Calculation was true, the Event proved; and that Mr *Bridges's* Engine is a Copy of that made Uſe of at *Weſtminſter* there is no Reaſon to doubt; whence then could ariſe the great Difference in the Calculation between Mr. *Bridges* and Mr. *Labelye*? but from the *former* not knowing the right Method of Calculation; for it will appear that if his Engine worked on equal good Principles with Mr *Labelye's*, it would give no leſs than 85 Strokes in an Hour, inſtead of 48 with two Horſes. Mr. *Bridges*, I preſume, willing to vary his Engine ſomething from the other, made his Weight 1200, and then concluded the Height muſt vary alſo, what that Height was to be, he determined by the *Rule* of *Three Direct*, inſtead of an *inverſe* Proportion, from his thorough Knowledge of Arithmetic; and he certainly might have ſaved himſelf the Trouble of making a Model of the Engine, as he could have bought one at a moderate Price at any of the *mathematical Inſtrument-Makers* in *London*.

The Method of building in *Caiſſons* is taken from Mr *Labelye*, but greatly miſunderſtood by Mr *Bridges*, who propoſes * to build the Pier in the Caiſſon, and afterwards float it to the Place where it is to ſtand; whereas Mr *La-*

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* Mr. *Bridges's* Letter, Page 36.

Labelye brought the Caiſſon empty to its Place and ‡ ſunk it as every Courſe of Stone was laid: The Abſurdity of Mr *Bridges*'s Intention muſt appear to every one who will conſider the Difficulty of floating a Veſſel, with, at leaſt 200 Tons Weight upon it, to its proper Situation, in ſo rapid a Stream as that at *Briſtol*, and if the Foundation ſhould be the leaſt unlevel, would not the Back of the Caiſſon be broke, and all the Band of the Work deſtroyed?

To return to the Examination of the firſt Deſign.---We are told that the Center-arch, at the higheſt Tides, will be only *one Foot eight Inches* * above the Water, and that the Side-arches will be buried *two Feet four Inches*. Mr. *Bridges*'s ſays this is † an ugly Circumſtance; indeed it is ſo! and a Deſign attended with it no experienced Perſon would have offered, as it muſt always endanger the Bridge: It may be aſked, why no ill Conſequence has attended the preſent old Bridge from the ſame Circumſtance? The Narrowneſs of the Bridge, the Form of the Arches, and the great Weight of Materials in the preſent Spandrels anſwer that Queſtion; but the Caſe will be quite different in ſemi-circular or elliptical Arches, and when the Bridge is *forty-four Feet* wide, inſtead of *nineteen*. Mr *Bridges*'s ſays‡ "this ugly

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‡ *Labelye*, Page 36.
* Mr. *Bridges*'s Letter, Page 13. † Ibid. ‡ Ibid.

" Circumſtance is not to be avoided, unleſs " by running into a worſe Extream, viz. raiſing " the Pent of the Bridge, which would not " only make it too laborious as a trading City, " but would alſo require a much larger Quan- " tity of forced Earth on the Banks." He certainly here forgets, or elſe he has never ſeen the common and excellent Method of raiſing Streets with arched Vaults, rendering forced Earth unneceſſary. And the Purchaſe of a few more Houſes would effectually prevent the ugly Circumſtance, without running into a worſe Extream; the Expence ſhould not be regarded, as it would not only improve the Navigation, but remove the Danger of the Water's raiſing too high on the Spandrels of the Arches.

If Mr. *Bridges* had propoſed his concave Cylinders, inſtead of eaſing the lateral Preſſure, to have been Openings in the Spandrels for Water-ways at high Tides, he would have ſhewn himſelf a Man of Judgment; I give him this Hint, he may adopt the Idea if he pleaſes, and for his Authority take the following Quotation from Mr. *Blondell*, who, in *his Cours D'Architecture* (P. 5. Liv. 1. Chap. 16.) *ſays*; " Scamozzi parlant des " Ponts de Florence, dit que le haut des leurs " Arches ſe trouvant au deſſous de l'Eau quand " la Riviere eſt fort enflée, il y arrive ſouvent " du deſordre qui pourroit á la fin cauſer leur

“ Ruine. Et c'eſt pour ce ſujet que nous avons “ des Architectes, qui dans les Reins des Voutes “ entre deux Arches, ont laiſſé des Vuides “ percez á jour tout au travers du pont en forme “ des grandes Niches au deſſus des Avances des “ Piles, ou quelſquesfois même en forme de “ grand Ronds, ou Yeux de Bæuf. Ce qu'ils “ ont fait avec beaucoup de Raiſon, tant pour “ favoriſer le Paſſage des Eaux dans leur de“ bordmens, que pour épargner la dépanſe “ & décharger d'autant de poids de Maçon“ neris les Rein des Voutes.”

When the Bridge is built according to this Deſign, “ *High-ſtreet* near the *Gate* which “ is now (ſays Mr. *Bridges**) ſo ſteep as to “ be 1 Foot in $7\frac{1}{102}$ may be made ſo eaſy in “ as 1 Foot in $10\frac{3}{4}$ or very nearly ſo, and the “ turning down to the *Back* will be only 1 “ Foot in $17\frac{64}{112}$.” This is by no Means a fair Repreſentation of the Fact, for it is not above 20 *Yards* that it is ſo ſteep, and according to Mr *Bridges*'s † Meaſurement the Fall, from *Maryport-ſtreet* to 20 *Yards* Southwards of Mr. *Taylor's* Shop, is about 25 *Feet*, and the Length 281 *Feet*; ſo that if that Length be made of one regular Declivity, it will be but a Trifle more than *one Foot* in *twelve*. Thus without the Trouble and Expence of rebuilding the Bridge, the Aſcent into *High-ſtreet* may be made eaſier than Mr *Bridges* propoſes it to be after an *immenſe* Expence.

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* Mr. *Bridges*'s Letter, Page 44. † Ibid, Page 36.

In fine, whoever conſiders this Deſign muſt with me conclude it IMPRACTICABLE, from the Danger and Difficulty of lengthening the OLD PIERS; but ſuppoſing that practicable, we ſhall, after the Expenditure of many thouſands, have a Bridge always in Danger of being thrown down by high Tides; the Navigation under it very little improved, for it cannot, no more than the preſent Bridge, be paſſed before the ſecond Quarter of Ebb, tho' Mr. *Bridges* tells us 'twill be ſo at the firſt Quarter; and the Aſcent into *High-ſtreet* ſo little eaſed, as to remain a Pitch of *one Foot* to 10 ¾ for 73 *Yards* in Length. The By-ſtander ſays, * " Caſt your Eyes upon his Deſigns of *three* " *Arches*, you will find them well conſidered." I am afraid no one will think ſo beſides himſelf, for the above Reaſons. I ſhall now proceed to examine

SECONDLY, *his Deſign with* THREE ELIPTICAL ARCHES *on the* OLD *Foundations, calculated to ſave Expence.*

The next Plan Mr. *Bridges* offers, is one with *three eliptical Arches*, liable to the ſame Danger from high Tides, and affording as little Improvement to the Trade and Navigation as the firſt Deſign, and to recommend it, he tells us that theſe Arches have the following good Reaſons in their Favour. "*Firſt*, "ſaving a Quantity of Maſonry: *Secondly*, "contain more Variety in their Figure: "*Thirdly*, will give more Water-way at extraordinary Tides: *Fourthly*, *and Laſtly*; "the fineſt Bridges in *France* have eliptical "Arches, I mean the *Pont Royal* at *Paris*; "and that at *Blois* over the *Loire*."

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* By-ſtander, Page 32.

To prove his *firſt* Aſſertion he gives a Rule of Proportion borrowed from Mr. *Muller*, and which he endeavours to demonſtrate by as falſe unworkman-like a Calculation as perhaps was ever offered by a Man; he never conſiders that as this Deſign is of equal Altitude with the former, the Height of the Piers muſt increaſe as the Height of the Arches decreaſe: The Quantity of ſolid Bulk ſaved is great, tho' not ſo much as he calculates; but then the Increaſe of ſuperficial Workmanſhip in the *eliptical* Arches will require deeper Vouſſoirs by a fourth than the *ſemicircular* ones, and therefore the Increaſe of valuable Materials, in the Arches and Piers, and the Workmanſhip, oppoſed to the ſaving a few hundred Perch of Rough-work, will bring the Ballance in Favour of the *ſemicircular* Arches; a Fact Mr. *Bridges* will be convinced of when he hath learnt to make a proper Calculation.

His *ſecond* and *third* Aſſertions I grant him, but let us conſider his *fourth* and *laſt*. In his ſecond Letter, (*entitled Mr. Bridges*'s *further Obſervations*) after uſing all the little Arguments in his Power to ſhew the Impropriety of eliptical Arches, and uſing the Terms *Concentric* and *Centropetal* in a Manner that ſhews he knows not what thoſe Terms mean; and telling us "he has * examined many of the "Works of the Antients, and finds no other "Form made Uſe of but the Segment of a "Semicircle, and that the moſt eminent Moderns have followed this Example."----- Then ſays, "Except in one Inſtance of the "Bridge over the *Arno*, which appears to be "very defective, † and for more than two "Centuries has never been imitated." It is very difficult to reconcile this Paragraph to the *fourth* Aſſertion, eſpecially as it is well known that *Pont Royal* was built in the Year ‡ 1685, and from Mr. *Blondel*, who was at that Time at the Head of the Academy of Architecture at *Paris*, we learn, that the Hint of this §

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* See his Further Obſervations, *Col.* 1.

† The Defect of this Bridge is not owing to its cycloidal Form, but from the Vouſſoirs not being ſufficiently deep: A Print of this Bridge may be ſeen in *Wright's* Travels, taken from a Drawing of Sig. *Galilei*, and it muſt be obſerved that this Bridge was not built for Carriages, but only for Perſons on Foot to paſs over.

‡ Deſcrip. de Paris par Brice, Tom. 3. P. 219.

§ *Blondel* Cours d'Arch. P. 5. L. 1. C. 16.

Bridge was taken from that over the *Arno*; and the Bridge at *Blois* was built in the Year || 1717. This ſhews at once the little Reading of Mr. *Bridges*, and his Diſingenuity, who to recommend his own eliptical Arches, mentions *two* Inſtances of the like Arches, and brings even a *third* Example, if the Bridge over the *Oiſe* bears a Similitude to this Deſign of Mr. *Bridges*: But to decry other Men's Deſigns he can tell there is but *one* Example of ſuch Arches known: Yet after all, in his laſt Addreſs to the Commiſſioners, he ſtill recommends his Deſign of eliptical Arches, with this Alteration, *to reduce their Width* (ſays he) *from 44 to 42 Feet as we can then build on the old Foundations with great Security, without Gratings.*

Mr. *Bridges* muſt have a very mean Opinion of our Underſtandings to think to perſuade us that ſo trifling an Alteration can give ſo great a Security as to render uſeleſs all that great Contrivance of Gratings which he has taken ſo much Pains to model, and which the By-ſtander ſo much applauds. In Truth it appears, that Mr. *Bridges* begins at laſt to diſcover the Error he was in, when he adviſed and deſigned the lengthening the old Piers. An Error that ſhews his little Judgment as well as Experience in Building.

|| **Hawkſmoor on Bridges, P. 36.**

This Deſign, therefore, for the very ſame Reaſon as the firſt Deſign, may be deemed IMPRACTICABLE. I have very little to ſay to his

THIRD *Deſign of* FIVE SEGMENT ARCHES *to ſpan the whole Breadth of the River on a* NEW *Foundation,*

And ſhall only obſerve that the pompous Deſcription of it had been more modeſtly made by another, than by Mr. *Bridges* himſelf; and its Similitude to the *Senatorian* Bridge is no more than that both are Bridges: The *Senatorian* Bridge has all its Arches equal, and they riſe * $\frac{1}{18}$ of the Diameter higher than a ſemicircle; whilſt this Deſign of Mr. *Bridges* has all its Arches Segments of Circles; the *Center one* large, and the *Side ones* decreaſing § in a certain Proportion. As this Bridge was propoſed to be the ſame Height with the preceeding ones, the Danger from the Water riſing ſo high on the Spandrels, renders it at leaſt *unadviſable* to be *executed* in our Caſe. An Objection to theſe Deſigns I forgot to mention, and that is, the *four* ſmall *paltry* Houſes that are to adjoin the Corners of the Bridge, which muſt not only be very inconvenient in themſelves, but muſt render the Approach to the Bridge much more ſo.

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* *Blondel* Cours d'Arch, P. 5. L. 1. C. 8.

§ Mr. *Bridges*'s Letter, Page 14.

The Commiſſioners having, as it were, reſolved to make Uſe of the *old Foundations*, this Deſign cannot be executed on them, and therefore 'tis needleſs to ſay any Thing more of it; ſo I ſhall proceed to examine his

FOURTH *Deſign of an* ARCH 130 *Feet Chord, and* 29 *Feet Altitude.*

I really am ſorry I cannot ſay ſo much in Praiſe of this Deſign as the * By-ſtander has; but on the contrary muſt declare *it* to be more *abſurd* and *impracticable* than any of the former ones; and rendered ſo, not only by the Difficulty and Danger of lengthening the *old* Foundations, but by the ſmall Depth of the Arch-ſtones; and by its ſpringing from an *old* Foundation on *one* Side, and from a Foundation partly *old* and partly *new* † on the other Side, the ill Conſequence of ſuch a Circumſtance muſt be obvious to every experienced Work-

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* The By-ſtander in Page 30 and 31 of his Letter, writes thus: "This noble and elegant Deſign ſhews what lofty Ideas the Author had when he ſat down to invent it. A Bridge which has no Relation to Mode or Faſhion! No Appendages but ſuch as are genuine, and will ſtand the Teſt of Ages! In ſhort he has introduced every Idea, that could ariſe from viewing the Veſtages of antient *Rome*. In ſhort this Deſign excells any Thing of the Kind in *Europe*; nay, perhaps the whole World, and every *Engliſhman* muſt wiſh to ſee it carried into Execution, eſpecially as it is greatly ſuperior in Utility, Strength, Elegance and Ingenuity, to any of the other Plans, that have been offer'd."

† Mr *Bridges*'s Letter, Page 28.

man: The Flatneſs of the Arch will have a very unpleaſing Appearance, and will be more and more diſagreeable as the Tide riſes, becauſe the Angle of the Segment becomes every Moment more acute; and at high Water will give (to uſe the By-ſtander's Words in Regard to Mr. *Stratford*'s Plan ‡) "the "diſagreeable Idea of an approaching Deluge, or its ſinking through the Bed of the "River."

Mr. *Bridges* tells us "there is a § fundamental Law in Architecture never to be violated, eſpecially as it is founded on the "eſtabliſhed Laws of Strength, viz. *As all* "*Arches increaſe in Diameter ſo ſhould the* "*Arch-Stones increaſe in Length and Thickneſs in a certain geometrical Proportion, as may* "*be ſeen at firſt Sight by inſpecting Mr.* Gautier's *Table of Vouſſoirs which I have now* "*before me.*"

Let us now ſee how cloſely he has followed this invariable Rule; the Arch-Stones for this great Arch he makes *five Feet eight Inches* deep, and gives the ſame Depth, all but *eight Inches*, to the Vouſſoirs, including the counter Arch, of his ſemicircular Arch *forty-five Feet* diameter; I beg Leave here to premiſe that *Gautier*'s Tables are calculated for Semicircles;

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‡ By-ſtander's Letter, Page 14.

§ Mr *Bridges*'s Letter, Page 23.

that all Segments require the ſame Depth of Arch-Stones as the Semicircle of which they are Part; and that an Arch 130 *Feet* Chord and 29 *Feet* Altitude is a Segment of an Arch of nearly 176 *Feet* diameter. Now from a Parity of reaſoning, if an Arch of 45 *Feet* diameter requires the Arch-Stones *five Feet* deep, will Arch-Stones of *five Feet eight Inches* deep ſupport an Arch of 176 *Feet* diameter? Or put it in the moſt favourable Way poſſible, that is, from the By-ſtander we learn Mr. *Bridges*'s counter Arch is *two Feet two Inches* deep, conſequently his Arch-Stones *three Feet ſix Inches* deep; is there any Proportion obſerved even in this Caſe, or does a Semicircle of *forty-five* diameter require a counter Arch of almoſt $\frac{2}{3}$ of its Depth to ſecure it, when an Arch of 130 *Feet* Chord requires none? Can any one ſay Mr. *Bridges* has well calculated or well adviſed in this Point? The Depth of *three Feet ſix Inches* which he gives to his Semicircle of *forty-five Feet* diameter, is the Medium betwixt the Meaſure *Gautier*, in his Tables, gives to ſoft and hard Stones; and an Arch of 176 diameter, by the ſame Rule and Tables, requires the Arch-Stones to be *eleven Feet eight Inches* deep. What Reaſon can be then given for Mr. *Bridges*'s quoting *Gautier* as a Pattern, following him in the firſt Inſtance, and not in his large Arch? I hope he does not intend to ſet his own Opinion in Oppoſition to *Gautier*, endeavouring

vouring to perſuade us that *five Feet eight Inches* Depth will be ſufficient for that Arch to which *Gautier* preſcribes double the Meaſure? Or did he think we had ſuch an implicit Confidence in what he ſays, that we ſhould believe this Quotation from *Gautier* true without further Scrutiny?

Mr. *Bridges* tells us that all his Arches riſe *one Foot eight Inches* higher than the higheſt Spring-tides; that at thoſe Times the Channel is 28 *Feet* deep, but at low Water 5 *Feet* deep; conſequently the Crown of his Arches are all 24 *Feet* 8 *Inches* above the Water; but his great Arch riſes 29 *Feet*, therefore ſprings *four Feet four Inches* under low Water: What the Uſe of this can be, is not eaſy conjectured, eſpecially as at low Water, his Arch, inſtead of being 130 *Feet* Chord and 29 *Feet* Altitude, will appear only 122 *Feet* Chord, and 24 *Feet* 8 *Inches* high; and I muſt here again obſerve the Abſurdity of pulling down the old Piers below the Level of low Water.

We will now conſider the Advantages this Arch will give either to the Paſſage over, or under the Bridge: If the Road be kept as low as Mr *Bridges* intends it in his other Plans, *to wit*, 4 *Feet* 8 *Inches* higher than the preſent Bridge, and the Arch Stones have the Depth directed by *Gautier*, whoſe Authority we have no

Right to diſpute, then will the Aſcent into *High-ſtreet* be as little eaſed as in thoſe Plans, and the Navigation be rendered leſs commodious than it is at preſent; becauſe the Water at the higheſt Tides will riſe upwards of 4 *Feet* above the Soffit of the Arch: On the other Hand, if the Arch ſprings from the ſame Level Mr. *Bridges* preſcribes, and the Arch-ſtones have their proper Depth, then will the Road over the Bridge be raiſed above the Level Mr *Wood* adviſes the Bridge to be raiſed to in his laſt Plan, but not attended with equal Advantage to the Navigation; for in Mr. *Wood*'s will be the ſame Water-way for the firſt two Quarters of the Flood; for the third Quarter very little leſs; and not above *ſeventeen Feet* contracted, at the laſt Quarter, in the three Arches; and then there will remain *eight Feet* Head-way in the Center of each Arch at the higheſt Spring-Tide known. Whereas Mr. *Bridges*'s Arch will have but 122 *Feet* at Low-water, be continually contracting 'till High-water, not in a regular Gradition as 1. 2. 3. but as 13. 17. 22. 35. whereby the Rapidity of the Tide will always be accelerated, and at High-water only 35 *Feet* Water-way, and *one Foot eight Inches* Head-way; beſides, the Angle the Arch makes with the Water is very acute, and becomes more ſo every Moment of the Flow, and conſequently more dangerous if the Veſſels that paſs under are driven near the Extremity of the Chord; for a Man, ſtanding in the Stern of a Boat, whoſe Head is but *five Feet* above the Water, cannot paſs this Arch at Low water within *ſeven Feet* of the End of the Chord, at firſt Quarter not within *nine Feet*, at half Flood not within *twelve Feet*, and at three Quarters not within *eighteen Feet*.

It will not be amiſs to make a Parellel between the Water-way of this Arch, and that of Mr. *Wood*'s Plan with *three* Arches, laſt offered, the Bridge in each Plan to be equally high.

Mr. *Bridges*'s one Arch.	F.	I.	Mr. *Wood*'s laſt Plan.	F.	I.
From Low-water to the Vertex of the Arch - - - -	24	8	From Low-water to the Vertex of the Arch - - - -	32	0
Vouſſoirs - - - -	11	8	Vouſſoirs - - - -	4	6
Covering - - - -	2	0	Covering - - - -	1	10
	38	4		38	4

And the Water-way and Head-room in each Deſign will ſtand thus :

In Mr. *Bridges*'s Deſign,

	F.	I.		F.	I.	
At Low Water	122	0	Water-way.	24	8	Head-room.
At 1-qu. Flood	109	0	Do.	18	11	Do.
At 1-hf. Flood	92	0	Do.	13	2	Do.
At 3-qu. Flood	70	0	Do.	7	5	Do.
At High-water	35	0	Do.	and impaſſable.		

In Mr. *Wood*'s Deſign,

	F.	*I.*		*F.*	*I.*	
At Low Water	127	8	Water-way.	32	0	Head-room.
At 1 qu. Flood	127	8	Do.	26	3	Do.
At 1 hf. Flood	127	8	Do.	20	6	Do.
At 3 qu. Flood	124	0	Do.	14	9	Do.
At High-water	140	0	Do.	9	0	Do.

From hence it is plain that ſmaller Arches will admit much more navigable Water-way than one large Arch at all Times of the Tide. Eſpecially when we conſider how much the Acuteneſs of the Angle of the Segment in the ſingle Arch renders uſeleſs of the Chord; and conſequently ſmaller Arches will be more commodious in our Caſe.

To make what I have ſaid ſtill plainer, in *Plate No.* 2. *Fig.* 5. I have deſcribed an Arch of 130 *Feet* Chord and 29 *Feet* Altitude, the Line L M is High-water Mark; N O, three Quarters Flood; T S, half Flood; P Q, firſt Quarter Flood; X Y, Low-water; and AB is *four Feet four Inches* below that Mark and the Level from whence Mr. *Bridges*'s Arch is to ſpring. By Inſpection it is here plain how diſagreeable the Appearance of the Bridge will be at High-water; how the Angles of the Segment at G, H, I, K, become more and more acute at each Period of the Tide; how much, and in what Degree the Water-way contracts, is denoted by the Lines G F, H E, I D, and K C; and the Parts

A X, and B Y, ſhew how much of the Arch is under Water.

In *Plate No.* 3. is a Plan and Elevation of Mr. *Wood's* laſt Deſign where the Line A denotes High-water; B, the 3d Quarter of Flood; C, the 2d Quarter; D, the 1ſt Quarter; and E, Low-water. The Letters cccccc ſhew the Coping the *old* Piers, and the Lines O O denote the Contraction of the Water-way at the two laſt Quarters of the Tide.

Mr. *Bridges* tells us one Reaſon to recommend this Arch, is, that it admits more Water-way than his other Deſigns; now he will find, if he calculates properly, that at the firſt, ſecond, and third Quarter of the Flood there will be much more Water-way in his own Deſign of three Semicircular Arches, than in his ſingle Arch; and that the whole Void of the ſingle Arch is conſiderably leſs than the Voids of the three Arches. I now proceed to examine his

FIFTH *Deſign of* 141 *Feet* 6 *Inches Span, and* 31 *Feet* 4 *Inches Altitude.*

This is a ſimilar Segment to the former, and conſequently attended with the like Inconveniencies, and therefore ſhall only obſerve two Things:

FIRST, That Mr *Bridges* tells us 'tis an Arch of 137 Degrees, whereas it is only between 95 and 96 Degrees, as has been fully proved in a late literary Diſpute.

SECONDLY, His *Quixote Calculation* of letting Ships of 300 Tons Burthen to paſs under it.

To accompliſh this great End he adviſes to ballaſt the River *four Feet eight Inches* lower than the Bed of the River; a curious Contrivance! every Tide will fill it up as every Bargeman well knows; but ſuppoſe that not to be the Conſequence, how will the Caſe ſtand then? Why even thus: The critical Time for paſſing is juſt at Low-water, according to Mr. *Bridges*'s own Calculation, if the Water riſes *two Feet* the Ship cannot paſs; therefore a Veſſel, that is going up, cannot be ſuppoſed to be a-float below Bridge any conſiderable Diſtance, and to ſail up in Time to paſs, ſo that ſhe muſt come up ſome Time before High-water, and be moored below Bridge during the Ebb; and a Veſſel coming down will be a-ground as ſoon as ſhe is through the Bridge, where ſhe muſt be moored during the next Flood, conſequently, as Cables and Hawſers muſt ſpread the whole River for that Purpoſe, the Navigation of it will be quite ſtopped during thoſe Times. Mr *Bridges* in his Calculation makes no Allowance for the Veſſel rolling, lifting, heaving or ſetting; for her not anſwering the Helm; or her going obliquely thro' the Arch; or her being drawn nearer one Shore than the other; and if in paſſing thro', ſhe is ſtopt by any Accident, it is a plain Caſe, that Holes muſt be made in her Bottom to ſink her, or ſhe will fairly weigh up the Bridge; ſo that for a Veſſel to paſs, there muſt be all theſe improbable concomitant Circumſtances, exact Time of the Tide; muſt neither roll, lift, heave nor ſet; muſt paſs exactly in the Center of the Arch, and at right Angles with the Breadth of the River. All theſe Things being conſidered, and particularly the waſte Space in Altitude taken up by the extraordinary Depth of the Arch-ſtones, muſt determine every one to condemn ſo large a ſingle Arch. Yet Mr. *Bridges* ſtill in his laſt Addreſs recommends it, tho' he leaves unanſwered the Objection, of the conſtant Spring of of Water flowing into the Foundation whilſt ſinking thro' a *Quickſand* 23 *Feet* to the Rock; this I am ſurprized he thought not of before, eſpecially as he had an Opportunity of boring, and even gives a Journal of it in his firſt Letter; and had Mr. *Bridges* the Knowledge and Experience of a common Maſon, this very Circumſtance would have made him reject ſo chimerical a Scheme. I cannot quit this Arch without obſerving Mr. *Bridges*'s GASCONADE in his laſt Addreſs, which is in the following Words.

“ This Arch, if we conſider its prodigious
“ Spand, its Breadth, the Regularity of its
“ Deſign, the Beauty of the intended Work-
“ manſhip, the Manner in which it is con-
“ ſtructed, the Depth of the River and Height
“ of the Tides, the vaſt Quantity of Water
“ that will paſs through it, without the leaſt
“ Obſtruction, the great Improvement it will
“ make in our inland Navigation, the Spaci-
“ ouſneſs and Commodiouſneſs of the Carriage
“ and Foot-ways over it, the Illumination
“ the globular Lamps on the Top, the agree-
“ able Airing over it, and the wonderful
“ Echo it will occaſion under it, will natu-
“ rally (to a Perſon who never ſaw the *Ri-
“ alto, Blenheim*, or the *Taaf*) cauſe a very
“ uncommon Senſation of Awe and Surprize;
“ as it would appear like an Over-ſtretch, or
“ an Extreme, and his Wonder and Attention
“ muſt be raiſed in Proportion as he is unac-
“ quainted with the Principles of its Conſtruc-
“ tion. But to thoſe who know the Subject,
“ there appears no Danger, all theſe Things and
“ many more that might be enumerated, muſt
“ certainly make this Arch a very great Orna-
“ ment to our City; and will be looked upon
“ with Pleaſure or Envy by all Foreigners,
“ as no ſingle Arch-Bridge, deſcribed or men-
“ tioned in Hiſtory, can equal it in every
“ particular Circumſtance; though poſſibly,
“ ſome of them may ſurpaſs it in one or two,
“ that might have happened rather from Na-

" ture and Accident, than from Art and " Contrivance."

This is wrote ſo much in the Stile of SEWARD's *Grand Performances* and *all Puppetſhew Hand-bills*, that it ſhews the Author of it muſt not only have a very mean Opinion of our Intellects to imagine we ſhall believe all that he aſſerts as true: but at the ſame Time it ſhews his Vanity, and his Ignorance of what Hiſtorians mention, for over the River *Allier* (the very River he mentions the *Bourbonois* to be built over) is a ſingle Arch at,* *Brioude* whoſe Chord is 195 *Feet* and Altitude 84 *Feet*; and is it not the greateſt Vanity to tells us that in Art and Contrivance he has ſurpaſſed all the Architects modern and antient? Does he think to compare the Art and Contrivance of his Arch to thoſe famous Arches of Antiquity which have ſtood the Teſt of Ages; was there no Art or Contrivance in the Builder of the *Pantheon*, the Dome † of which is 133 *Feet* diameter; none in *Michael Angelo*, the Architect of the Dome of *St. Peter*'s at *Rome*, of the *Rialto* at *Venice*, and of moſt of the Bridges at *Florence*; none in *Palladio*; none in the Architect of ‡ *Pont du Gard* that conſiſts of three

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[*] Antiq. de *Montfaucon*, T. 4. P. 2. L. 1. Cap. 5.

[†] Meſures de *Rome* par *Deſgodetz*, Cap. 1.

[‡] Antiq. de *Montfaucou*, T. 4. P. 2. L. 1. Cap. 5.

three Tier of Arches; none in the Builder of the § *Aquaduct* of *Segovia*; none in *Caius Lacer*, the *Architect* of that famous Bridge of * *Alcantara* in *Spain*? Or to bring us near Home, is there no Art or Contrivance in the great Arch in the Cathedral of *Glouceſter* that ſupports the whole Tower, or in the inverted Arches at *Wells* Cathedral, or in Mr. *Etheridge's* Timber Bridge at *Walton?* Do all theſe Men owe the Merit of their Works to mere Accident? And are Art and Contrivance Attendants on Mr. *Bridges* alone? For my own Part I ſee neither Art nor Contrivance in this his ſo boaſted an Arch; but on the contrary, an Oppoſition to all Rule and Experience. The flatneſs, or ſmallneſs of the Segment is oppoſite to the Opinion of the moſt celebrated Architects; and the ſmall Depth of his Vouſſoirs contrary to the Authority of *Gautier*, *Belidor*, and every other Perſon of Knowledge.

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§ *Udal ap Rhys* in his Account of the moſt remarkable Places in *Spain*, (printed in the Year 1740) deſcribing the City of *Segovia*, ſay thus: " But nothing in its Kind is to be compared " to its *Aquaduct* in all *Europe*; it was built in the Reign of the " Emperor *Trajan*, and extends from one Mountain to another, " which is at *three* Miles Diſtance. It is 144 *Feet* high, ſup- " ported by an *hundred and ſeventy ſeven* vaſt Arches, raiſed " above one another in *two* Rows, and conveys a ſufficient Quan- " tity of Water to ſupply the whole City. It is built with vaſt " ſquare Stones, which are joined together without any Cement. " It is remarkable that the Structure of this *Aquaduct* is of ſo " ſolid a Nature, that it has wanted very little Reparation, even " to this Day; and whatever has been added by the Moderns " has laſted but a very ſhort Time."

* *Montſaucon* in his Supplement. L. 5. C. 2. tells us, that this Bridge built over the *Tagus* is 662 *Feet* long, 24 *Feet* broad, and conſiſts of *ſix* Arches, the two Middle ones 110 *Feet* Opening and Semicircles, and the Piers 38 Feet thick; from the Foundation to the Surface of the Water is 37 *Feet*; from thence to the ſpringing of the Arch 87 *Feet*; and from thence to the Top of the Pavement of the Bridge is 77 *Feet* in all 201 *Feet*: The Bridge was built in the Reign of *Trajan*, and in the Year of *Chriſt* 105; the whole Structure is built without any Cement, with immenſe large Stones. I have ſomewhere ſeen a Deſcription of this Bridge agreeing in every Circumſtance with *Montſaucon's*, but with theſe other following Particulars; *firſt*, that it is not in a ſtrait Line over the River, but makes an Angle in the Middle againſt the Stream, which is a great Maſter-piece of Art when we conſider the Length, Height, and ſmall Breadth of the Bridge, and to which may be attributed its long Duration; *ſecondly*, that the Depth of the Vouſſoirs is 7 *Feet* and *a Half*.

This large Arch ſpringing fromthe ſame Level with the Arch of 130 *Feet* Chord will riſe *two Feet ſix Inches* higher than that Arch, and is a Segment of a Circle 194 *Feet* diameter; in hard Stone *Gautier* gives *twelve Feet ten Inches* for the Depth of the Vouſſoirs of ſuch an Arch; if therefore we follow that Author's Advice in Preference to Mr *Bridges's* Opinion, and which I hope we ſhall for the public Satisfaction and Benefit, then will the new Bridge be raiſed higher than Mr *Wood* propoſed; and we ſhall incur an extraordinary Expence of 4163 Pounds without benefiting the Navigation, and ſtill be liable to the Expence of purchaſing the ſame Houſes that a leſs expenſive and more commodious Plan would require. This Fact I hope will appear plain to every one, and Mr. *Bridges's* Calculation in his laſt Addreſs to the Commiſſioners proved as it is, deceitful and falſe.

The By-ſtander, Page 34 ſays, "I beg "Leave to name a few of his (Mr *Bridges*'s) "ingenious Inventions that have been looked "over by 99 out of a 100; wherein he goes "beyond any of his Cotemporaries;" probably he may in the Eyes of the By-ſtander, who ſeems a very Ignoramus by this laſt curious Obſervation; I will take the following Method to examine the ſeveral

Inventions attributed to Mr. Bridges *by the By-ſtander, with Obſervations.*

I. The Method of building the Caiſſion is an Improvement on that made Uſe of at *Weſtminſter* Bridge, and ſplitting them in the Middle, to be floated away, after they preſerv'd the Pier dry from laying the Foundation under Water.

Obſerv. *This is no Improvement at all, the ſame Method being made Uſe of in building the Piers on the* Lambeth *Side of* Weſtminſter *Bridge, as may be ſeen in* Labelye's *Deſcription of that Bridge.*

II. The Method of ſawing his Piles off cloſe to the Water, whether the River be high or low, rapid or ſmooth, is curious.

Obſerv. *The ſame was done at* Weſtminſter *Bridge by the ingenious Mr.* Etheridge, *as may be ſeen in the Print he publiſhed in the Year* 1745, *of the Machine he invented for that Purpoſe.*

III. His Method of ſupporting the Centers from Offsets in the Sides of the Piers, and by that Means ſaving a Number of Piles.

Obſerv, *This Method is pointed out in* Gautier's *Treatiſe on Bridges, and was executed in the Bridge over the Avon called the* New Bridge *within two Miles of* Bath, *the Offsets remaining in that Bridge to this Hour.*

IV. And trying the Foundations, as mentioned in his Drawings.

Obſerv. *This Manner I have ſeen made Uſe of not only in the Bridge over the* Thames, *but in all Works whoſe Foundations are laid under Water; and Mr.* Bridges's *Deſcription of it is taken Verbatim from Mr.* Labelye.

V. Alſo, the Improvement made on the Center itſelf, and Manner of joining and lowering it.

Obſerv. *As to the Improvement on the Center, whether it is ſo or no I will not take upon me to determine; but ſurely the By-ſtander forgets the excellent Method made Uſe of in* Weſtminſter *Bridge to lower the whole Center at once, as I do not recollect Mr.* Bridges's *Method. I cannot ſay whether 'tis copied from the abovementioned Manner, or no; but it is plain Mr.* Bridges *has invented no new Thing.*

VI. The Manner of conſtructing his three Arches with two Centers only, which is ſo ſimple, ſays the By-ſtander, that I wonder it has not been found out before now.

Obſerv. *This Wonder to the By-ſtander ſhews him very little converſant in Works of this Kind, and to be a very improper Perſon to pretend to examine and give Judgment of Plans for a Building; for this is no Invention of Mr* Bridges, *but the common Practice of all Engineers: In the 92d and 93d Pages of Mr.* Labelye's *Deſcription of* Weſtminſter *Bridge, we are told that the Centers, on which the weſtern Arches of* Weſtminſter *Bridge were turned, were taken down, and ſet up again, for the building of the correſponding Eaſtren Arches.*

VII. The Form which he gives the Ends of his Piers, in the ſame Drawing, as the beſt for cutting the Water, is, I think without Doubt, better than any other hitherto made uſe of; it is made like the Bow of a Boat.

Obſerv. *This very Form is adviſed by* Paladio, *in the Tenth Chapter of his Third Book, and by* Gautier, *in the Twentieth Chapter of his*

Trea-

Treatiſe on Bridges, and is executed in the Fabrician, Ælian *and* Milvian *Bridges at* Rome.

Thus we ſee what a Novice the By-ſtander is, to attribute the Invention of Men, that lived ſo many Years ago to Mr. *Bridges*, who, I am ſure, has more Modeſty than to claim any of the above Inventions to himſelf. And I muſt farther obſerve, that the By-ſtander has offered a great Affront to our Judgments, in attempting to impoſe theſe Inventions on us for the Contrivances of Mr. *Bridges*.

Having examined Mr. *Bridges*'s ſeveral Deſigns, and ſhewn them I hope, to the Satisfaction of every conſiderate Perſon, as I firſt propoſed, IMPRABTICABLE; and proved Mr *Bridges* a PLAGIARY; I will now proceed to examine his laſt Addreſs to the Commiſſioners, entitled, *Mr. Bridges's Reaſons both* for *and againſt a Single Arch Bridge*.

By the Exordium of this Epiſtle, we are given to underſtand, that he had expreſs Order of the Commiſſioners * to model a Bridge of *One* Arch, and to give *impartial* Reaſons both *for* and *againſt* a Deſign of that Sort; and alſo to think of ſome Kind of Carriage for conveying Stone from the Quarry to the Bridge, to be contrived, if poſſible, in ſuch Manner, as not to deſtroy, or break up the Roads: How well, and how much to the Purpoſe he has complied with this Order, let us now examine.

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* It is to be wiſhed that the Commiſſioners had deſired Mr. *Tully*, Mr. *Stratford*, and Mr. *Wood* to have given their Opinions of an *one* Arch Bridge, as probably they might have received rather a *better* Information from thoſe *Gentlemeu* than from Mr. *Bridges*.

In the firſt Place, he refers us to his two firſt Addreſſes to the Commiſſioners, ſaying, that in thoſe Addreſſes "he has ſaid ſo much§ "as to have but little more to add," and then tells us, that the Objections to a ſingle Arch Bridge are reduced to *Four:* Firſt, *Strength;* Second, *Expence;* Third, *'Twill admit too much Water-way at the Time of Freſhes againſt the Veſſels lying at the Back and Slip below;* Fourthly, *The conſtant Spring of Water flowing into the Foundation while ſinking to the Rock.* Theſe Objections he pretends to have anſwered in the following Manner.

I. After a *Cock-and-Bull* Story of the Foundation of *Redcliff* Church, he very wiſely tells us, that "If *the Abutments of this Bridge can* "*be laid on the Rock, and the Arch-Stones* "*proportioned thereto, there is not the leaſt Reaſon* "*to doubt of its ſufficient* Strength." This Fact we were convinced of without Mr. *Bridges*'s Information; and his If leaves *us*

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§ The Arguments Mr. *Bridges* makes Uſe of in thoſe Addreſſes I have ſufficiently anſwered in the foregoing Sheets.

ſtill in the Dark, and the *Objection* ſtill unanſwered: To have been ſatisfactory, he ſhould have determined what the Depth of the Archſtones *was to* be; and he ſhould have aſſured us that the Foundation *could* have been laid on the Rock.

II. His Anſwers to the ſecond Objection is as little to the Purpoſe, as that to the firſt; but as it is ſomewhat curious I will give it in his own Words: " It is certain (ſays he) the " Expence of this Bridge will exceed that, of " any Scheme yet offered either on the old, " or on the new Foundations; but when " every Advantage is juſtly conſidered, and " weighed impartially, 'twill prove the cheapeſt. In Mr. *Glaſcodine*'s Time, *Briſtol* " Bridge was much the Topic of Converſation: Nay, that very Gentleman, with " Mr *Tully*, Mr *Patty*, Mr *Manly*, Mr *Daniel*, and other able experienced Workmen, " were requeſted by the worthy Members of " our Corporation, (who had the Affair much " at Heart) to conſider of this Matter. They " were divided in their Opinions as to the " moſt eligible Scheme, ſome were for three " ſemicircular Arches on the old Foundation, " particularly Mr *Tully*, *with whom I always* " *joined in Opinion in that Article*; others " again were warm Advocates for three ſemicircular Arches on a new Foundation, particularly Mr *Glaſcodine*; and Mr *Stratford*

" of *Glouceſter* has embraced that Gentleman's " Doctrine, and accordingly has furniſhed " you with an Eſtimate amounting to 16,673 " Pounds. And I will take upon me to ſay, " the ſingle Arch Bridge will not exceed " 17,348 Pounds, *(if the fourth Objection " can be overcome.)* And I alſo believe it will " not exceed the Scheme of three ſemicircular " Arches on the old Foundation above 4163 " Pounds. A Sum in my Opinion not ſuffi- " cient to ballance the Advantages mention- " ed." Of this Anſwer I muſt obſerve; firſt, that Mr *Bridges* has no where made the great Advantages of a ſingle Arch appear; ſecondly, that his mentioning Mr *Stratford*'s Eſtimate is a ſly Inſinuation, that his own Plans are *cheaper* and *preferable* to that Gentleman's; Mr *Bridges* ſhould have been ſilent on that Head 'till ſuch Time, that his Opinoin was aſked; and by mentioning Mr *Stratford*'s Eſtimate, he has taken a moſt unbecoming Liberty; thirdly, that although he always thought a Bridge with three Arches the moſt eligible Scheme, yet he is ſo much our Friend as to adviſe us to build a ſingle Arch Bridge.

III. The third Objection he thus anſwers; " This Objection I look upon as of little " Weight; becauſe the Veſſels lying at the " Back will be as free from all Land Floods " and Freſhes as they now are, (from the " great Pillars dividing the Current) becauſe

" the Stream will then run more over on the " *Redcliff* Shore, conſequently the Veſſels will " lie ſecure; and thoſe at *Bridgwater* Slip " cannot, in the Nature of Things, alter their " Condition for the worſe, as the Arch will " be *nine Feet* wider than the Riveris at that " Place, or in any other Part below Bridge." It is Pity Mr. *Bridges* had not recollected that this laſt Aſſertion is directly oppoſite to what he before advanced in his firſt Letter, where he tells us, that† " when the Water of a River hath ſome of its Parts obſtructed, the " Depth is encreaſed by ſo much as the obſtructed Water riſes to; and on the other " Hand when the Breadth of a River increaſes " more and more wide, the Depth of the " Water is diminiſhed, the ſame Quantity of " Water being ſpread over a larger Surface, " which Diminution is always in Proportion " to the River's Breadth." Is it not plain therefore from this Manner of Reaſoning, that if the Water-way at the Bridge be wider than the River at *Bridgwater* Slip, that the Water at the Slip muſt be obſtructed, become deeper, and the Current ſtronger; whilſt on the other Hand, if the Arch at the Bridge admits leſs Water-way than there is at the aforeſaid Slip, that, in that Caſe, the Channel will be here increaſed in Breadth, the Depth of the Water diminiſhed, and the Force of the Current abated.

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† See Mr. *Bridges*'s Letter, Page 33.

IV. The fourth Objection he tells us is only in *Part* anſwered, and ſays thus: "The great "Time and Difficulty attending the digging "out and laying the Foundation of the Abutments on the Rock, 23 Feet below the "Bed of the River, is an Obſtacle of a very "unuſual Nature; being ſuch as probably "never did, or never may happen again. "The only Method I can adviſe, to obviate "this knotty Point, would be to dig and lay "theſe Butments in ſmall Portions, about 10 "by 12, or 13 by 15 Feet Square as will be "better explained by the Model. But even "then, if the Land, or Spring Water ſhould "flow into the Foundation (as we dig between the Tides) as faſt, or faſter than it "can be thrown out, I ſay, in that Caſe who "can anſwer for the Succeſs of ſuch an Undertaking, as the Foundation of all Buildings are of the greateſt Importance in Reſpect to the Strength and Duration of the "the whole, and in none greater than in this; "on the Occaſion I have lately read and examined *Belidor*, *Vauban*, *Coeborn*, and "*Muller* on Foundations in general, but have "not been able to meet with a ſimilar Caſe." How ſatisfactory this Anſwer is I will leave to the Reader to determine, and ſhall only obſerve, firſt, That the *Cheſt-Work* Mr *Bridges* adviſes, is ſo far from carrying with it the leaſt Probability of Succeſs, that it is, in our Caſe, the moſt abſurd Method that could have been offered, as there can be no Band through the whole Work; ſecondly, that Mr. *Bridges* read the Authors, he above mentions, with little Attention, as * Mr. *Belidor* in particular is very explicit in his Deſcription of Foundations on Quickſands; thirdly, That if Mr. *Bridges* had ſpoke like a Man of Judgment, he would have told us, that the Attempt to ſink for a Foundation 23 *Feet* deep under the Bed of a River, and for 10 *Feet* thro' a *Quickſand* would be attended with ſuch Expence, and ſuch Difficulty, that he muſt adviſe us to deſiſt from ſuch an Undertaking; but ſuppoſing it could be done, the Impropriety of letting an Arch have one Abutment on an *old* Foundation and the other on a *new* one, would be unſurmountable.

Thus, gentle Reader, I have laid before you Mr. *Bridges*'s Anſwers to the Objections to a large ſingle Arch, and I dare ſay you will think with me, that the Anſwers ſtrengthen, rather than confute the Objections; and you will likewiſe with me pronounce, his large Arch to be IMPRACTICABLE,

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* Science des Ingenieurs, Liv. 3, Chap. 9.

I will now conſider Mr. *Bridges*'s curious Carriage, in which he has ſhewn as little Knowledge in Mechanics, as he has before in Architecture with Regard to the Bridge. His Deſcription of the Carriage is as follows: "One of the principal Peculiarities in this "Carriage, is, the Difference between the "Length of the Axle of the fore Wheels and "hind Wheels. It is propoſed that the *Out-* "*ſide* of the hind Wheels ſhall run in a Line "with the *Inſide* of the fore Wheels, and the "Fellies nine Inches broad. By this Means, "the Wheels, tho' only nine Inches each, "will make a Roller, or Cylinder equal to "18 Inches. This Poſition of the Wheels "cannot fail to keep the Roads quite level, "for the following Reaſons.

"The Space between the Thims of the "fore Wheels will be equal with the hind "Wheels of the *London* Waggons, (*viz.* 5 "Feet 8 Inches) the double Horſe Track "may be computed at 1 Foot 4 Inches "each, and the two hind Wheels at 1 Foot "6 Inches, which added together will ſtand "thus; hind Wheels 1 Foot 6 Inches, Horſes "Tracks doubled 2 Feet 8 Inches, in all 4 "Feet 2 Inches; which, ſubtracted from 5 "Feet 8 Inches, the Width between the fore "Wheels, leaves juſt 1 Foot 6 Inches of "Ground unbeaten. Now it muſt be ob-"ſerved that the 18 Inches of unbeaten Ground

" by this Means will be cut into *three* diſ-
" tinct Ridges of 6 Inches each; *one* in the
" Middle between the Horſes Tracks, and
" one on each Side between the hind Wheels."
The Thought of having one Axle ſhorter than the other is very pretty; but by Mr *Bridges* miſapplied, as the ſhorter Axle ſhould be before, and ſhould run under the Bed of the Waggon; becauſe if the high Axle is placed behind, either the Bed of the Waggon will become too narrow for any Uſe; or it muſt be elevated ſo high, as not only to render the loading and unloading troubleſome, but will throw the Center of Gravity ſo high, that the Carriage will be ſoon overturned: And it is impoſſible for Horſes to work in Harneſs ſo *cloſe* as Mr. *Bridges* propoſes, who is likewiſe miſtaken in regard to the Diſtance between the Thims of the Wheels, which cannot by the late Act of Parliament be more, in Broad-wheel Waggons, than *four Feet nine Inches*, that is, *eleven Inches* leſs than he mentions. He then tells us that
" by having the fore Wheel of a large Dia-
" meter, it may be thought a difficult Mat-
" ter for the Waggon to lock and unlock;
" but nothing can facilitate the turning of this
" Carriage ſo much, as the Axle of the fore
" Wheel, being 1 Foot 6 Inches longer than
" the Axle of the hind Wheel." This is oppoſite to all Reaſon, and to all Experience; for the Pole of a Coach and the Axle make a *bended Lever*, the Pin is the *Fulchrum*, and

conſequently the longer the Axle is, in Proportion to the Pole, the leſs the Purchaſe will be to lock and unlock the Carriage. Mr. *Bridges* next ſays thus: "The Waggon "Cheſt I have placed a little higher behind "than before, an Expedient, by which the "loading that lies over the hind Wheels, will "be made rather to incline or puſh on the "fore ones." This Expedient ſhews Mr. *Bridges* to be very little acquainted with the Laws of Mechanics; for the Bed of the Waggon placed as he propoſes, becomes an inclined Plain; and its Effect will only be to throw the Center of Gravity of the Loading nearer the fore Wheels, and retard rather than puſh them forwards.

I cannot poſſibly give the Credit of the Thought of having one Axle ſhorter than the other to Mr. *Bridges*, becauſe about *three* Years ago Mr. *John Cox*, Innholder, at the *George* in *Fairford, Glouceſterſhire*, ſhewed to ſeveral Gentlemen in theſe Parts a Model of a Broad-wheel Carriage, conſtructed in the following Manner; the *hind Wheels* were of the ſame Height and Breadth, and the Axle of the ſame Length with the common Broad-wheel Waggons; but the *fore Wheels* were of leſs Diameter, and ran under the Bed of the Waggon; to counterballance the additional Friction theſe ſmaller Wheels would neceſſarily have, they were very judiciouſly made, *one Foot* broad, *nine Inches* of which ran in clear of the hind Wheels, ſo that the *fore* Axle was *one Foot* ſhorter than the *hind* ones, and the Tracts were *eighteen Inches* wide, excluſive of what they would gain by the *Play* of the Wheels, and would wear more ſmooth and even by having the *hind* Wheels follow on *three Inches* of the *fore* ones, than if the Wheels juſt cleared one another. The Horſes in this Carriage were to draw at length, or double at Option, tho' at length will be of more Advantage to the Roads.

Mr. *Cox* has built a Waggon after the Model, and about four Months ago, in Company with ſeveral Gentlemen, I ſaw it worked on the Road between *Cirenceſter* and *Fairford*, when it gave general Satisfaction: A noble Earl in the Neighbourhood of *Oxford*, was ſo pleaſed with the Model that he took it home, and I hear is ſo well convinced of the Utility of the Carriage, that it is believed he will endeavour to oblige all *Common Stage Waggons* to be made in that Form.

If the Commiſſioners would like to ſee the Carriage, Mr. *Cox*, for Ten Guineas, would bring it to *Briſtol* for their Inſpection. Although this Carriage of Mr. *Cox*'s is the beſt *four Wheel'd* one I ever ſaw, yet if the Commiſſioners will have the Stone brought from the Quarries near *Briſtol*, I take upon me to recommend to them the *high two Wheel* Carriage with *broad Wheels*, a *Friction Lever*, and a *Drag Staff*, made Uſe of in the North of *England*, particularly at *Liverpool*.

Thus much of this Reply I had prepared for the Preſs, and was proceeding farther to vindicate Mr. *Stratford's* Plans, and to ſhew that the By-ſtandar was nought but a *Plagiary*, when by Accident I ſaw the Conſiderations on the By-ſtander's Letter, by Mr. *Stratford*, who has ſo well performed the Taſk, that I have little more to add; but in his Words will pronounce, that both Mr *Bridges* and his Friend the By-ſtander's Letters, are mere *Piratical Tranſcripts*.

In whatſoever Light we look on the Motive that ſet the Pen of the By-ſtander to work, from his Partiality we muſt conclude them to be bad ones; as a Friend to Mr. *Bridges* he has certainly miſſed his Aim, becauſe the Freedom, he took with Meſſrs. *Wood*, *Stratford*, and *Tully*, by declaring their Plans impracticable, he muſt needs think, would draw on a Vindication of them, and at the ſame Time, lay Mr. *Bridges* open to a ſtrict Scrutiny.

To the Public he has proved himſelf an Enemy, becauſe he would gratify private Friendſhip at the Expence of public Intereſt, by attempting to perſuade the Commiſſioners to follow Deſigns, which he muſt know were bad in themſelves, and which they in the End and perhaps too late might diſcover. The Varniſh the By-ſtander has thrown on theſe Deſigns, to make baſe Metal to paſs for true Sterling, I have endeavoured to waſh off; if I have ſucceeded, and if the Public are ſerved by it, my End is anſwered.

I ſhall therefore conclude by leaving the Reader to determine Mr. *Bridges*'s Merit as an Author, from his numerous *Plagiariſms*; his Skill as an Engineer from the Deſcriptions of his *Models*; and from *all his Plans*, his Knowledge in deſigning, and his Claim to the Name of ARCHITECT; *an Appellation too often proſtituted*, as Mr. RIOU very juſtly obſerves in the Preface to his moſt ingenious Diſſertation on Bridges, publiſhed in the Year 1760, where in Page xiii. he writes thus: *Having ſignified, that the Name of Architect is too commonly proſtituted, let us give a ſlight Sketch of the Qualifications requiſite in this Character. Firſt, the Baſe of all others, on Account of the great Truſt, ſhould be a perfect Integrity; then, as Sir* H. Wotton *obſerves, "that Architecture can want no Commendation, where there are noble Men or noble Minds," it muſt follow, that the Profeſſor of it ſhould poſſeſs moſt of the liberal Endowments, and maintain a due Connection with other Arts*

Arts and Sciences; far from being educated with a TROWEL *in his Hand, his Education ſhould have been planned, as* Horace *informs us of his own, by the Care and Indulgence of an affectionate Father or Parent,*

> —— puerum eſt auſus Romam portare, docendum
> Artes, quas doceat quivis eques, atque ſenator
> Semet prognatos.

In fine, I will take upon me to recommend to Mr. *Bridges* the cloſe Study and Obſervance of the following trite Line of *Martial*,

QUOD SIS, ESSE VELIS, NIHILQUE MALIS.

FINIS.

Plate N°. I.

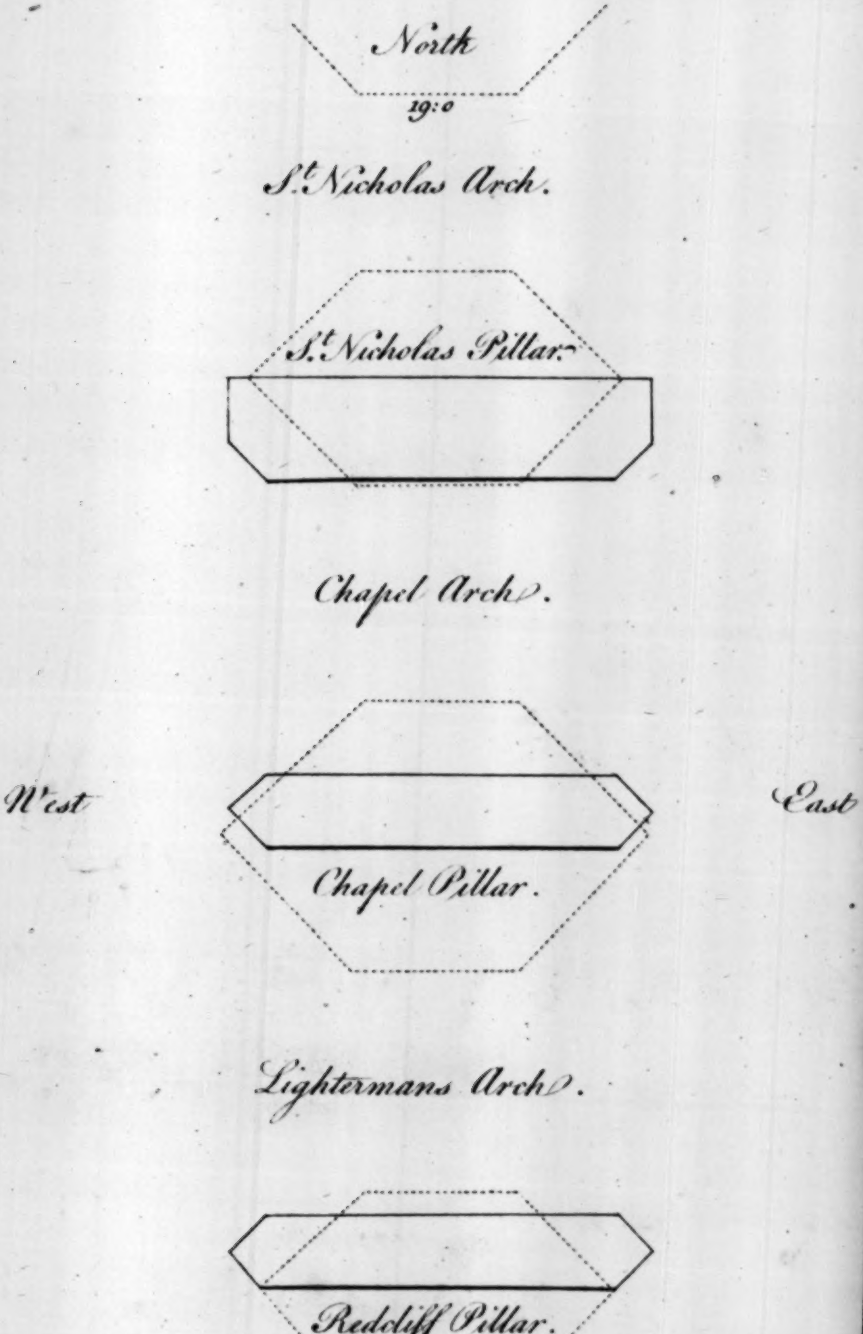

North
19:0
St. Nicholas Arch.
St. Nicholas Pillar.
Chapel Arch.
West
East
Chapel Pillar.
Lightermans Arch.
Redcliff Pillar.
Redcliff Arch.
Redcliff Abutment.

Plate Nº. II.

Fig. 1.

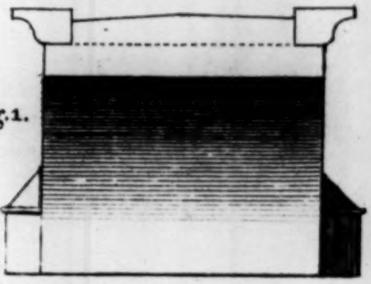


Fig. 3.

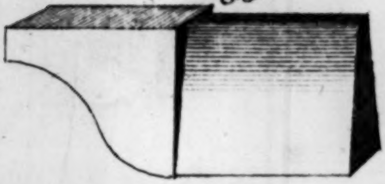


Fig. 4.

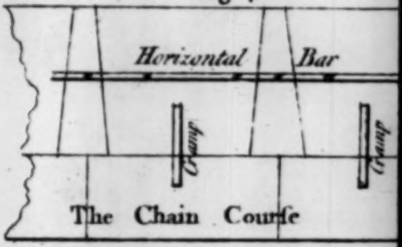


Fig. 2.

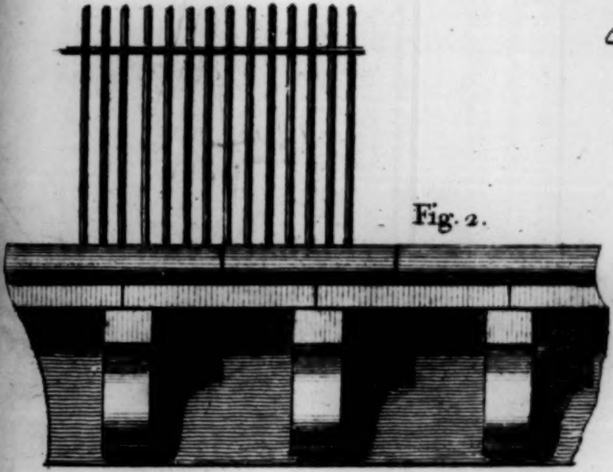
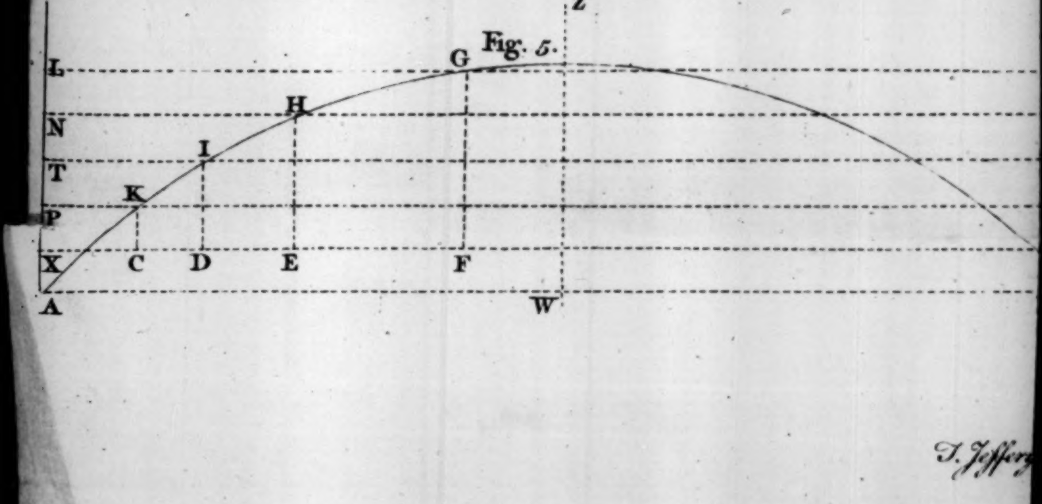
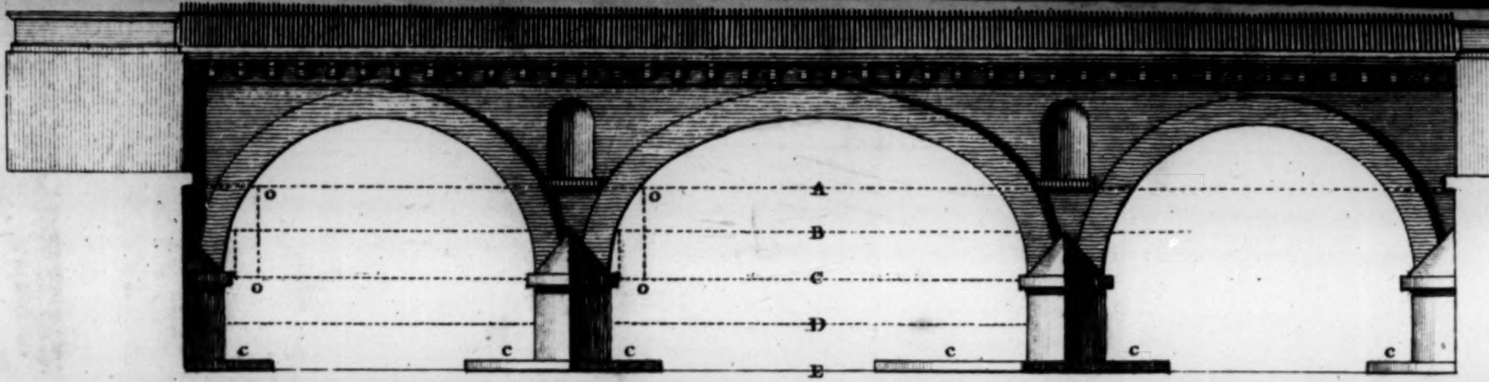


Fig. 5.



T. Jeffer

Plate No. III.



Plan, and Elevation to the East, of Mr. Wood's Design for a three arched Bridge on the Old Foundations at Bristol